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NITI Aayog

PATHWAYS & STRATEGY FOR ACCELERATING GROWTH IN EDIBLE OIL TOWARDS GOAL OF ATMANIRBHARTA

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Pathways and Strategy for Accelerating Growth in Edible Oil towards Goal of Atmanirbharta

2024

शिवराज सिंह चौहान

SHIVRAJ SINGH CHOUHAN

D.O. No....92......../AM

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कृषि एवं किसान कल्याण और
ग्रामीण विकास मंत्री
भारत सरकार
कृषि भवन, नई दिल्ली

**Minister of Agriculture & Farmers Welfare
and Rural Development
Government of India
Krishi Bhawan, New Delhi**

Message

India ranks among the world's top oilseed producers. The country accounts for approximately 5-6% of global oilseed production. Oilseeds play a crucial role in the agricultural economy. In the financial year 2022-23, India exported around 3.46 million tonnes (MT) of oil meals, oilseeds, and minor oils worth ₹14,609 crores. In FY 2022-23, the Indian oilseed cultivation area was 30.1 million ha, producing 41.3 MT of oilseeds. The domestic supply of edible oils was 12.4 MT, while imports stood at 16.5 MT. Since there is a huge gap between the country's edible oil production and demand, we import about 57% of the total edible oil consumption to meet our demand. This mostly comes from South East Asia, Latin America and Russia.

The Hon'ble Prime Minister of India has emphasized the urgency of boosting domestic edible oil production to reduce this dependency. Reducing the import bill and stabilizing the prices of agricultural commodities are major priorities of our government, and to achieve this, the Ministry of Agriculture and Farmers' Welfare launched NMEO-OP in August 2021 with an ambitious budget of ₹11,040 crore to expand oil palm cultivation to 10 lakh hectares.

The document "Pathways and Strategy for Accelerating Growth in Edible Oils towards Goal of *Atmanirbharta* " outlines comprehensive guidelines to encourage stakeholders to invest in and adopt advanced practices, with a focus on expanding horizontally and vertically within the edible oils sector. Research and Development (R&D) will play a crucial role in this effort by focusing on developing high-yielding varieties, widespread adoption of modern farming techniques, market linkages & procurement, value addition, and crop insurance. This strategy will not only boost production but also improve the incomes of our farmers, processors, and entrepreneurs.

I congratulate and commend the efforts of the Agriculture and Allied Sectors vertical of NITI Aayog for coming up with such a comprehensive strategy. I urge everyone to actively engage and implement the outlined strategy for the larger benefit of our country and economy. By working together, we can achieve self-sufficiency in edible oils, ensuring the prosperity of our farmers and sustainable economic growth for our nation.

With regards,

(Shivraj Singh Chouhan)

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Message

India currently imports nearly 57% of its edible oil demand, making it vulnerable to global price fluctuations and supply disruptions. Achieving greater self-sufficiency in edible oils is crucial for reducing dependency on volatile international markets, and ensuring national food security. This will foster an ecosystem that supports local farmers, enhances agricultural incomes, and stimulates rural economies.

This report offers a comprehensive roadmap for reducing India's dependency on imports and ensuring food security. It also outlines a robust strategy for strengthening the domestic edible oil sector, formulated in consultation with Institutes of the Indian Council of Agricultural Research, Indian Vegetable Oil Associations, and a survey of farmers conducted by NITI Aayog. The strategy, which is both pragmatic and visionary, focuses on leveraging horizontal and vertical expansion, promoting high-yielding climate-resilient and bio-fortified crop varieties, as well as fostering innovations in processing and value addition.

I congratulate NITI Aayog's team on Agriculture and Allied Sectors for a high-quality document that covers important aspects of the edible oil sector. I am confident that the recommendations will serve as an invaluable guide for industry, researchers, and India's farming community.

Suman Bery

प्रो. रमेश चन्द
सदस्य
Prof. Ramesh Chand
MEMBER

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PREFACE

It is frequently claimed that Green Revolution enabled India to attain food self-sufficiency. One area where the country suffered serious setback in self-sufficiency, rather than improving it, is vegetable oil or edible oil. Historical data shows that India imported tiny, less than one lakh tonne, edible oil per year till early 1970s. Stagnation in domestic production during the second half of 1970s led to surge in import to 15 lakh tonne by 1980-81 and the second surge to 20 lakh tonne by 1987-88. This caused considerable concern in the country and it was decided by the then policy planners to exploit potential of domestic oilseed production to reduce import and improve self-sufficiency. The country then launched Technology Mission on Oilseeds (TMO) in the year 1986 to increase domestic production and reduce import dependence. TMO involved support and promotion for production and processing technology and remunerative price environment for oilseeds producers. Imports were strictly regulated through a policy of canalisation. In a short period of six years following TMO, domestic production of oilseeds increased by 78%, from 11.3 million tonne to 20.1 million tonne, and import fell from close to 2 million tonne in 1987-88 to mere 1 lakh tonne in 1992-93. TMO thus met its main goal of self-sufficiency in edible oils.

Then came the era of liberalisation followed by WTO. Pro liberalisation sentiments started prevailing over self-reliance and the government opened up edible oil sector to import. This liberalisation of import of edible oil stopped the progress of TMO and subjected Indian oilseed production to compete with cheap palm oil from Malaysia and Indonesia. This marked the beginning of sustained surge in import of edible oil and decline of oil seed economy of the country. The second major reason for surge in import of edible oil into India is stagnant or low growth in productivity of oilseeds as compared to high growth in the world and major vegetable oil exporting countries.

The government has already undertaken several initiatives to improve self-sufficiency in edible oils including palm oil. The report provides comprehensive analysis of production, prices and trade in oilseeds and vegetable oil in the country and explore various options to reduce the gap between production and demand. It also suggests range of measures covering technology, policy support, price intervention, trade measures and programmes like missions on edible oil to march towards the goal of self sufficiency

I congratulate the Agriculture and Allied Sectors vertical at NITI Aayog for their dedication and hard work in producing this comprehensive and insightful strategic report for attaining self-sufficiency in edible oils. I hope all stakeholders will find this report useful in boosting edible oil economy of the country to help us achieve self-sufficiency in edible oil.

(Ramesh Chand)

Place : New Delhi
Date : 31st July, 2024

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FOREWORD

Today, India stands at a crucial juncture in its journey towards self-reliance in edible oils. Oilseeds and edible oils are important in India's consumption basket. However, the majority of our edible oil demand is met through imports. Therefore, edible oils are essential to our nation's food security. With a vast and diverse agricultural backdrop, we have the potential to transform our edible oil sector to meet both our domestic demand and also emerge as a significant player in the global market.

We import around 16.5 million tonnes of edible oils annually, which accounts for nearly 57% of our domestic consumption. The domestic production of edible oilseeds has increased marginally. However, the gap between production and demand for edible oil is ever-increasing due to population growth and improvements in people's living standards. This significant dependency on imports underscores the urgent need for a robust strategy to boost domestic production and achieve self-sufficiency.

This report titled "Pathways and Strategy for Accelerating Growth in Edible Oils towards Goal of *Atmanirbharta*" presents a comprehensive plan to transform the edible oil economy in India. The strategy outlined in this report results from extensive and continuous engagement with various stakeholders, including farmers. This timely report reflects the government's commitment to fostering economic growth, empowering farmers, and creating a sustainable and self-reliant ecosystem for edible oil production in India.

I congratulate the Agriculture and Allied Sectors team at NITI Aayog for their dedication and hard work in producing this comprehensive and insightful report.

24/7

[B.V.R. Subrahmanyam]

Dated: 24th July, 2024

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July 31, 2024

Acknowledgement

It gives me immense pleasure to dedicate this report titled **"Pathways and Strategy for Accelerating Growth in Edible Oils towards the Goal of *Atmanirbharta*"** to the nation at a point in time where it is most needed. The COVID-19 pandemic has been detrimental to globalisation and sparked a demand for protectionism, aligning with India's national strategy of '*Atmanirbharta*' and 'vocal for local.' The edible oil industry, a vital component of the agricultural economy, is no exception since oilseed crops are the second most important determinant of the farm economy, next only to cereals. Despite the self-sufficiency achieved during the "Yellow Revolution" in the early 1990s, the per capita edible oil consumption surge has led to increased reliance on imports, with 16.5 MT imported in 2022-23. India fulfils only 40-45% of its edible oil needs domestically. This study presents a comprehensive roadmap to address this challenge, discussing projected demand-supply gaps by 2030 and 2047 and proposing strategic interventions to bridge the existing gap. The insights presented in this report are hoped to inform policymakers, industry stakeholders, and researchers in pursuing a resilient and self-sufficient edible oil sector.

The strategies outlined in this report for accelerating growth in the edible oil sector and achieving self-reliance are underpinned by a multifaceted approach structured across three key pillars: crop retention and diversification, horizontal expansion, and vertical expansion. The report advocates for a holistic development strategy involving the formation of crop-specific clusters, optimal utilization of rice fallow lands, targeted oilseed cultivation in regions with high potential, and enhancing oilseed development in areas like Bundelkhand and the Indo-Gangetic Plain. To improve value addition and reduce import dependency, the study emphasizes the modernization of oil mills, strengthening processing infrastructure, and optimizing seed utilization. Additionally, the report explores the potential of expanding oil palm cultivation in the northeast region by utilizing suitable wastelands while promoting secondary oil crop production to reduce import reliance and mitigate the demand-supply gap.

First and foremost, I would like to take this opportunity to express my sincere gratitude to Hon'ble Vice Chairman Shri Suman Bery, NITI Aayog. His encouragement and profound inspiration have been instrumental in driving our efforts. I am profoundly indebted to Shri B.V.R Subrahmanyam, CEO, NITI Aayog. His visionary leadership, continuous guidance and strategic direction ensure that our work meets the highest quality standards. I also thank Prof. Ramesh Chand, Hon'ble Member, NITI Aayog, for his valuable guidance, suggestions, and directional inputs, which helped us refine and bring coherence to the report. I thank all the Members of NITI Aayog for their support and contribution.

I extend my compliments and gratitude to Dr. Pravakar Sahoo, Program Director, Economics & Finance and Dr. Bhavesh Garg, Assistant Prof., IIT Ropar, for supporting this journey. The support

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provided by Dr V. P. Chovatia, Vice Chancellor, and Dr B. Swaminathan, Assistant Professor, Junagadh Agricultural University, also deserves a special mention.

The successful completion of this report is a testament to the collective efforts of the Agriculture and Allied Sectors Vertical. I sincerely thank the entire team for their invaluable contributions, particularly those involved in the rigorous primary data collection across seven major oilseed-growing states of India, which provided the foundation for this study.

Special recognition is extended to Dr. Harshika Choudhary, Consultant Grade-I and Shri Sambuddha Goswami, Consultant Grade-II, for their exceptional commitment and hard work in preparing this report. Their contributions have been invaluable to the success of this report.

Thanks to the distinguished reviewers from IIOPR-Andhra Pradesh, IIOR-Hyderabad, IISR-Indore, DRMR-Bharatpur, and CFTRI-Mysore, for their critical comments and valuable suggestions. I am also grateful to the edible oil associations, especially The Solvent Extractor's Association of India (SEA), The Soybean Processors Association of India (SOPA), and the Indian Vegetable Oil Producers' Association (IVPA), for their continuous brainstorming sessions throughout the preparation of the report.

I am grateful to the line ministries, especially the Ministry of Agriculture and Farmers' Welfare, for their support and for providing timely data. I also thank the state departments of Andhra Pradesh, Uttar Pradesh, Rajasthan, Karnataka, Madhya Pradesh, Maharashtra, and Haryana for arranging the hassle-free and smooth collection of primary survey data from farmers.

I thank Shri Yugal Joshi, Program Director, and Ms. Keerti Tiwari, Director of communications, NITI Aayog, for their thorough review and diligent document proofreading. Lastly, I would like to thank and acknowledge the role of every other stakeholder who has contributed actively or passively to making this document as and when time demands. With its comprehensive roadmap and strategic interventions, I am confident that this document will not only trigger a new paradigm of thinking but also serve as a practical guide for all States to identify gaps and implement interventions, thereby shaping a more resilient and self-sufficient future for the edible oil sector.

(Neelam Patel)

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ABBREVIATIONS

ABBREVIATIONS

AICORPO	All India Coordinated Research Project on Oilseeds
AIDS	Almost Ideal Demand System
ADF	Augmented Dickey-Fuller Test
ACF	Autocorrelation Function
ARIMA	Autoregressive Integrated Moving Averages
AAGR	Average Annual Growth Rate
BIC	Bayesian Information Criterion
BAU	Business as Usual
CCPA	Central Consumer Protection Authority
CSS	Centrally Sponsored Scheme
CMIE	Centre for Monitoring Indian Economy
CACP	Commission for Agricultural Costs & Prices
CAGR	Compound Annual Growth Rates
CPI	Consumer Price Index
CPO	Crude Palm Oil
CDVI	Cuddy-Della Valle Instability
DA&FW	Department of Agriculture & Farmers Welfare
ECA	The Essential Commodities Act
ELM	Extreme Learning Machines
FAOSTAT	Food and Agriculture Organization Statistic
FSSAI	Food Safety and Standards Authority of India
FFBs	Fresh fruit branches
GRNN	Generalized Regression Neural Network
GMGR	Geometric Mean Growth Rate
GDP	Gross Domestic Product
HCE	Household Consumption Expenditure

ICMR	Indian Council of Medical Research
IIOPR	Indian Institute of Oil Palm Research
IMSCS	Indian Minimum Seed Certification Standards
ISOPOM	Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize
IODP	Intensive Oilseeds Development Programme
ISTA	International Seed Testing Association kg/person/year- Kilogram/ person/ year
kg/ ha	Kilogram/hectare
KPSS	Kwiatkowski-Phillips-Schmidt-Shin test
Lha	Lakh hectares
MKO	Mango Kernel Oil
MAE	Mean Absolute Error
MAPE	Mean Absolute Percentage Error
Mha	Million hectares
MT	Million tons
MSP	Minimum Support Price
MoAF&W	Ministry of Agriculture & Farmers Welfare
MoSPI, GoI	Ministry of Statistics and Programme Implementation, Government of India
MPCE	Monthly Per Capita Consumption Expenditure
NAAS	National Academy of Agricultural Sciences
NFSM	National Food Security Mission
NIN	National Institute of Nutrition
NMEO-OP	National Mission on Edible Oil-Oil Palm
NMOOP	National Mission on Oilseeds and Oil Palm
NOPD	National Oilseeds Development Project
NSC	National Seed Corporation
NNI	Net National Income
Oil-SEA,	The Solvent Extractors' Association of India- International ICRBO Conference on Rice Bran
OPAE	Oil Palm Area Expansion
OPVOpen	Pollinated Varieties
OECD-FAO	Organization for Economic Co-operation and Development- Food and Agricultural Organization
POME	Palm Oil Mill Effluents

PACF	Partial Autocorrelation Function
PP	Phillips Peron test
PUFA	Polyunsaturated Fatty Acids
PFCE	Private Final Consumption Expenditure
PPP	Public-Private Partnerships
QUAIDS	Quadratic Almost Ideal Demand System
RDA	Recommended Dietary Allowance
RBD	Refined, Bleached, and Deodorized
RMSE	Root Mean Squared Error
SATHI	Seed Traceability, Authentication and Holistic Inventory
SMR	Seed multiplication ratio
SOPA	The Soybean Processors Association of India
SRR	Seed Replacement Rate
TMO	Technology Mission on Oilseeds
TMM Act	The Trade and Merchandise Marks Act, 2017
t/ha	Tonnes/ hectare
TPM	Transitional Probability Matrix
TBO	Tree Based Oilseeds
USDA	United States Department of Agriculture
WSO	Watermelon Seed Oil
WHO	World Health Organization
YOY	Year-on-Year

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The COVID-19 pandemic has been detrimental to globalisation and sparked a demand for protectionism, aligning with India's national strategy of 'Atmanirbharta' and 'vocal for local'. Oilseed crops are the second most important determinant of the agricultural economy, next only to cereals within the segment of field crops. The self-sufficiency in oilseeds achieved during the "Yellow Revolution" in the early 1990s was short-lived and could not be maintained for long. Over the past decades, per capita consumption of edible oil has witnessed a dramatic rise, reaching 19.7 kilograms per year (kg/year). This surge has outpaced domestic production and has translated into a heavy reliance on imports to meet domestic demand and industrial needs. Consequently, the import volume of edible oils reached 16.5 MT in 2022-23, representing a rise of about 67%, highlighting a growing dependence on external sources. India currently fulfils only 40-45% of its edible oil requirements through domestic production, presenting a significant challenge to the nation's 'self-sufficiency' goal.

India's heavy reliance on edible oil imports, currently accounting for 55-60% of its needs, presents a substantial challenge to its food security and economic stability. Given the multifaceted benefits of achieving "Atmanirbharta" (self-sufficiency) in this sector, a multi-pronged approach is imperative. To address this critical issue, this study outlines a comprehensive roadmap focusing on:

i. To analyse the performance of the edible oil sector in India by examining trends in area, production and yield of major oilseeds in India and the world.

ii. To examine the trends in the import and export of the edible oil sector.

iii. To discuss the gap between the country's demand and supply of major edible oils.

iv. To assess the past strategies to achieve self-reliance in the edible oil economy.

v. To develop new strategies and suggest a roadmap to achieve Atmanirbharta in edible oils.

This report comprehensively explores India's edible oil sector, detailing its current state and future potential across six chapters, and charts a path toward self-sufficiency. The introductory chapter sets the rationale for achieving self-reliance in edible oils, highlighting its significance for national food security and economic stability. Chapter-II highlights the perspective to include the global context, analysing trends in production, yield, and consumption of edible oils, underlining India's significant role in the dynamic global market.

Chapter-III explores a detailed analysis of the domestic edible oil sector. It examines state-wise dynamics, growth trends, factors contributing to production instability, and the intricacies of India's trade patterns in edible oils.

Chapter-IV comprehensively analyses trends for major edible oils in India, alongside detailed demand and supply projections for 2030 and 2047. The report employs three distinct approaches for demand forecasting to gain a multifaceted understanding of future edible oil needs. The Static/Household Approach utilizes population projections and baseline per capita consumption data, assuming a short-term static pattern in consumption behaviour. In contrast, the Normative Approach considers the recommended healthy intake levels established by the ICMR-National Institute of Nutrition (ICMR-NIN). Finally, the Behaviouristic Approach recognizes the potential for behavioural shifts in consumption patterns driven by increasing income levels, price fluctuations, evolving lifestyles, and changing dietary habits. The chapter analyzed potential gaps between demand and supply by these contrasting scenarios.

Chapter-V has the demand and supply analysis with a roadmap for achieving self-sufficiency in edible oils. This chapter outlines a comprehensive strategy designed to bridge the existing gap and ensure long-term growth in domestic production. Key strategies include crop diversification and retention and implementing a "quadrant strategy" that identifies clusters of states (i.e., high area-high yield, high area-low yield, low area-high yield, and low area-low yield) based on their potential for specific edible oil crops. This focused strategy helps allocate resources effectively to each cluster's strengths, including horizontal and vertical expansion of edible oil cultivation. The chapter further proposes strategic actions such as utilizing the fallow rabi rice area and adopting improved and advanced crop-specific technologies for edible oil production. Here, the chapter also explores the untapped potential of palm oil cultivation. To assess the potential impact of these strategies, the chapter estimates the increase in total production. It presents the required growth rates necessary to compensate for rising domestic consumption trends by 2030 and 2047 under two scenarios: existing practices and the proposed strategic interventions.

Chapter-VI highlights valuable insights from a primary field survey conducted by NITI, Aayog. This survey includes a sample of 1,261 farmers across seven major oilseed-growing states (Rajasthan, Maharashtra, Madhya Pradesh, Uttar Pradesh, Haryana, Andhra Pradesh, and Karnataka). It provides first-hand perspectives from the farmers growing oilseed crops. Building on these insights and the comprehensive strategies and roadmap outlined in the previous chapter, the final chapter presents recommendations for achieving “Atmanirbharta” in the edible oil sector.

By implementing the strategic roadmap and recommendations outlined in this report, India can ensure “Atmanirbharta” in the edible oil sector with national food security and economic stability.

Key Highlights:

1. Global Perspective and India's Position

i. The global economy for edible vegetable oils[1] has seen steady expansion over time, with forecasts for 2024-25 predicting a 2% rise in production, reaching 228 MT. This increase is anticipated to be fuelled by significant advancements in soybean, palm, and rapeseed oil production, alongside moderate sunflower seed oil production growth.

ii. Global oilseed production has increased nearly tenfold[2] since 1961, rising steadily from 57.02 MT. Although the cultivated area for oilseeds has expanded, production has grown much faster. The global oilseed yields also doubled from 5.7 t/ha in 1961 to 13.16 t/ha in 2022-23, reflecting increasing efficiency in oilseed production.

iii. Despite this growth, the world population has grown by 1.5% over the same period. This population expansion directly contributes to the rise in global oilseed consumption.

iv. The growth rate of vegetable oils has indeed been surpassing that of oilseeds over the past three decades due to the inclusion of palm oil, olive oil, coconut oil, and cottonseed oil, which are not traditionally classified under oilseeds and led to vegetable oils outpacing oilseeds in growth.

v. Palm oil is in high demand because of its exceptionally high yield (14.6 t/ha) compared to other vegetable oils. Soybean oil also remains in high demand because the non-oil fraction of soybean is valuable as high-protein animal feed and, more recently, for other uses such as biodiesel.

vi. Soybean has consistently been the global leader among oilseeds cultivation countries, covering an average area of 127.2 Mha during 2017-18 to 2022-23, far surpassing other oilseeds like rapeseed (36.3 Mha) and groundnuts (30.3 Mha).

vii. Soybean crop accounted for nearly 60% of the total global output over the past six years (2017-18 to 2022-23), with an average production of 353 MT and an average global yield of 2.8 t/ha. Rapeseed (75.9 MT), sunflower seed (53.2 MT), and groundnut (52.2 MT) follow soybean in terms of production, with average yields of 2.1 t/ha, 1.9 t/ha and 1.7 t/ha, respectively.

viii. Palm oil emerges as the frontrunner in global edible oil production, with an average production volume of 75.5 MT annually. Soybean oil follows closely behind with 58.9 MT, then rapeseed or canola oil, with an average production of 25.1 MT, and sunflower oil at 19.1 MT, secures the third and fourth positions, respectively, during 2017-18 to 2022-23.

ix. Palm oil currently leads global vegetable oil consumption, followed by soybean oil, rapeseed oil (canola oil), and sunflower oil. The USDA's (2024) global market analysis report projects nearly 3% growth in vegetable oil consumption for food purposes, with significant gains anticipated for soybean and palm oil and modest increases for rapeseed oil. Sunflower oil consumption is expected to decrease slightly.

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1. Includes coconut oil, cottonseed oil, groundnut oil, linseed oil, sesame seed oil, olive oil, palm oil, rapeseed oil, safflower seed oil, soybean oil, and sunflower seed oil.

2. Includes groundnuts (excluding shell), rapeseed, linseed, sunflower seed, safflower seed, soybean seed, sesame seed, and castor seed.

x. India, the 5th largest economy globally, is a significant player in the global edible vegetable oil sector, ranking fourth behind the USA, China, and Brazil. It contributes a substantial global share, accounting for roughly 15-20% of the global oilseed area, 6-7% of vegetable oil production, and 9-10% of total consumption. Despite these statistics, India still faces a shortfall in meeting its domestic demand, leading to substantial imports.

xi. India is at the top in rice bran oil production (46.8% of global market share) and demonstrates clear dominance. Similarly, India is a leader in castor seed production with an impressive 88.48% global share. The country is second in cottonseed oil production (28.41% share), following China. For groundnut seeds and oil, India ranks second with shares of 18.69% and 16.34%, respectively, trailing China and the USA.

xii. The country ranks third in coconut (in shells) and coconut (oil) production behind Indonesia and the Philippines and for sesame seed oil production behind China and Myanmar, contributing 22.46%, 14.2%, and 8.73% of the global market share, respectively. In rapeseed production, India has the third position (13.72% of the global share, behind Canada and China). In contrast, rapeseed or canola oil production ranks fourth (11.2% share, behind Canada, Germany and China), highlighting its significant role in rapeseed-mustard cultivation.

xiii. India is the world's fifth largest producer of soybean and soybean oil (behind Brazil, USA, Argentina and China), contributing 3.72% and 2.14% of the global market share, respectively.

xiv. Further, India ranks fifth in linseed production (3.18% share, behind Russia, Kazakhstan, Canada and China) and sixth in linseed oil production (5.03% share), with established players like China, Belgium, USA, Germany and Russia posing challenges in this segment.

xv. Despite its strengths in various oilseed sectors, a critical gap exists in India's palm and sunflower oil production. Less contribution to the global market for these oils hinders India's overall competitiveness on the international stage. India must prioritise strategies to boost domestic palm and sunflower oil production to achieve greater self-sufficiency and enhance its position in the global edible oil market.

xvi. While India ranks among the largest global producers, a closer look reveals significant disparities in yield compared to other major producing countries. Nearly all edible oil crops have displayed lower yields in the last three decades than other global producers, except for castor.

xvii. India's production of edible oils from secondary sources presents a picture of uneven performance. While being the second-largest producer of seed cotton (unginned) globally, India falls short in yield, highlighting a significant gap.

xviii. It is noteworthy that global producers achieve higher yields than Indian oilseed crops primarily due to the use of genetically modified (GM) herbicide-tolerant varieties. However, there is an opportunity for India to leverage its existing strengths in edible oil production and implement targeted strategies to close yield gaps.

2. Overview of India's Edible Oil Sector

i. Within Indian agriculture, oilseeds hold the second-highest position in the area, and production, surpassed only by food grains. India's diverse agro ecological conditions enable the cultivation of nine annual oilseed crops, including groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower, nigerseed, castor and linseed. However, a major challenge lies in rainfed agriculture, with 76% of the oilseed cultivation area contributing 80% of total production. Rainfed agriculture is particularly susceptible to biotic and abiotic stresses, jeopardizing overall production stability and poses a significant risk of reducing overall production, necessitating implementing strategies to enhance crop resilience.

ii. Nine major oilseeds account for 14.3% of the gross cropped area in India, contribute about 12-13% to dietary energy, and account for about 8% of agricultural exports. Soybean reigns supreme, occupying the largest area at 11.74 Mha, followed by rapeseed and mustard at 7.08 Mha. Groundnut cultivation holds the third position with 5.12 Mha. Sesame (1.58 Mha) and castor seed (0.89 Mha) are other significant contributors. Sunflower, linseed, nigerseed, and safflower occupy considerably smaller areas, with safflower cultivation at a minimum of 0.07 Mha.

iii. Among nine major oilseeds, soybean leads with 34% of the total oilseed production, followed by rapeseed & mustard (31%) and groundnut (27%), contributing to more than 92% of total oilseeds production. This underlines the dominance of soybean, rapeseed-mustard, and groundnut in India's oilseed production.

iv. The major contribution to domestic edible oil production comes from rapeseed-mustard oil (45%), groundnut oil (25%) and soybean oil (25%). The minor edible oilseeds (sesame, sunflower, safflower, and nigerseed) contribute about 5% of the total domestic oil production.

v. Rajasthan and Madhya Pradesh have the highest production of oilseeds, about 21.42% each of the national production, followed by Gujarat (17.24%) and Maharashtra (15.83%). Together, these four states contribute to 75.63% of the total production in the country.

vi. A closer look reveals geographic variations in dominance for specific crops. Rajasthan leads mustard cultivation, while Madhya Pradesh excels in soybean production. For sunflower and coconut, Karnataka and Kerala emerge as frontrunners, respectively. It is noteworthy that Uttar Pradesh and West Bengal hold significant areas for rice cultivation, whereas Maharashtra and Gujarat lead in cotton production.

vii. The national average yield of oilseeds has been 1.27 t/ha. States such as Tamil Nadu (2.5 t/ha), Gujarat (1.91 t/ha), Haryana (1.94 t/ha), Telangana (1.80 t/ha), Rajasthan (1.46 t/ha) have a higher yield than the national average. On the other hand, states such as West Bengal (1.19 t/ha), Maharashtra (1.18 t/ha), Uttar Pradesh (1.03 t/ha), Madhya Pradesh (0.99 t/ha), Karnataka (0.94 t/ha) have lower yield than the national average.

viii. Madhya Pradesh, Maharashtra, and Rajasthan account for 92% of India's soybean oilseed production. As for groundnut, Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, and Karnataka collectively contribute 83.4% of the country's total production. Similarly, Rajasthan, Haryana, Madhya Pradesh, Uttar Pradesh, and West Bengal collectively contribute 87.9% of India's total rapeseed and mustard production. This trend is observed across various oilseed crops, emphasizing the concentrated production contribution from states. These concentrated production patterns necessitate policy interventions to encourage oilseed cultivation in other suitable states, nurturing a more geographically balanced and resilient oilseed sector for India.

ix. Regarding secondary oil crops, significant contributions to palm oil production come from Andhra Pradesh (87.3%), Telangana (9.8%), Kerala, and Karnataka. Meanwhile, Gujarat leads in cotton production with a 24.4% share, followed by Maharashtra, Telangana, Rajasthan, and Karnataka, which collectively contribute 77.3%. Coconut production is dominated by Kerala, followed by Tamil Nadu and Karnataka, contributing 84% of the total production in the country.

x. Tree-borne oilseeds (TBOs) like wild Apricot, cheura, kokum, olive, simarouba, mahua, sal seed, mango kernel, dhupa, and tamarind seed offer oils with diverse uses. For instance, wild apricot in Himachal Pradesh yields oil for cooking and industry. Cheura from Sikkim and West Bengal is valued for cooking, medicines, and cosmetics. Kokum, mainly grown in Goa and Maharashtra, is used in chocolates and biodiesel. Olive cultivation, introduced through Indo-Israel collaboration, has potential in Rajasthan and other states. These oils could reduce India's reliance on imports.

3. Growth Trends and Instability in Edible Oil Crops

The area, production, and yield of oilseeds experienced trend growth rates of 0.90%, 2.84%, and 1.91%, respectively, during 1980-81 to 2022-23. Notably, in the most recent decade, production and yield displayed growth rates of 2.12 % and 1.53 %, respectively. The total area under oilseeds showed a positive growth trend in all decades except during 1991-2000.

i. In the last decade, groundnut, rapeseed-mustard, and linseed exhibited positive yield growth rates of 4.2%, 3.2%, and 3.9%, respectively. Sesame, safflower, nigerseed, and rice also demonstrated favourable yield growth rates in the same period. Conversely, soybean, sunflower, coconut, and cotton experienced negative productivity growth trends during the same period.

ii. The crops showing negative growth trend rates in the cropped area are safflower (-16.99%), nigerseed (-10.37%), sunflower (-9.07%), linseed (-6.32%), castor (-3.29%), sesame (-2.05%), and groundnut (-0.25%) in last decade. Conversely, all secondary oil crops have shown positive trends in their cultivation area.

iii. Amongst the secondary oil crops, rice, from which rice bran is extracted, showed a positive trend over the decades. However, cotton and coconut experienced a positive trend in the area in the last decade but a negative trend in production and yield. The total palm oil production in India for 2021-22 has reached 0.36 MT from 0.079 MT in 2010-11.

iv. The instability analysis suggests that when a longer period is considered, reflecting the widespread adoption of improved technology across large areas, the notion of increased instability due to new technology adoption is refuted. In the last decade, only sunflower and safflower experienced fluctuating areas, highlighting challenges in maintaining consistent cultivation patterns for these crops.

4. Edible Oil Trade Dynamics

i. Edible vegetable oils stand out among agricultural commodities due to their exceptionally high trade volume. A staggering 41% of global production is traded internationally, largely driven by major palm oil producers like Indonesia and Malaysia. These giants export over 70% of their production, jointly accounting for nearly 60% of global palm oil exports.

ii. India faces a significant challenge in achieving edible oil self-sufficiency. It is heavily dependent on imports to meet its edible oil requirements and is the largest importer of vegetable oils globally, followed by China and the USA.

iii. Import dependence on edible oils decreased from 63.2% in 2015-16 to 54.9% in 2021-22. This translates to increased self-sufficiency from 36.8% to 45.1%. However, this progress is overshadowed by the stark rise in overall consumption. This ever-widening gap is plugged by significant imports, which have grown from a mere 1.47 MT in 1986-87 to 14.19 MT in 2021-22. The concerning trend continued in 2022-23, with imports further surging to an estimated 16.5 MT, pushing the import dependency ratio back to 57% from 55% in 2021-22.

iv. Palm oil dominates these imports, accounting for 59%, followed by soybean (23%) and sunflower (16%).

v. Open General Licenses (OGLs) are a crucial facilitator, enabling essential imports to bridge the demand-supply gap for edible oils in India. Import duty structures are strategically reviewed to balance the interests of various stakeholders. Temporarily, measures were introduced to stabilize cooking oil prices for consumers directly to control the rise in cooking oil prices. These measures included reducing basic import duties on crude palm, soybean, and sunflower oil to zero while significantly lowering the agri-cess from 20% to 5%. Additionally, the basic import duty on refined palm oils was reduced from 17.5% to 12.5% in December 2021, and the same on refined sunflower and soybean oil was reduced from 17.5% to 12.5% in June 2023. This revised structure, extended until March 31st, 2025, demonstrates the government's ongoing efforts to manage import costs for refined oils. Most significantly, the government extended the free import policy for refined palm oils until further notice. This combination of import duty adjustments, temporary exemptions, and extended free imports highlights the complex nature of India's dynamic import policy.

vi. Further to encourage domestic production, the government annually announces MSPs for 22 mandated crops, including seven key oilseeds, namely groundnut, sunflower, soybean, sesame, nigerseed, rapeseed & mustard, and safflower. Since 2018-19, MSPs have been set at a minimum of 1.5 times the cost of production. Over the period (2014-2024), the MSP for oilseeds has seen a significant increase, with nigerseed showing the highest relative change of 142.1%. Notably, the sesamum MSP has more than doubled with a 101.5% rise, while sunflower seed and soybean have also seen substantial growth at 94.1% and 91.1%, respectively. This producer-centric approach provides financial security for farmers, incentivizing increased oilseed cultivation.

vii. Groundnut, sesame, soybean, and rapeseed are the main exported oilseeds, with groundnut being the largest exported crop for the last three consecutive years. In terms of edible vegetable oil exports, castor oil stands out as the front-runner, followed by groundnut oil and other oils. Soybean and rice bran are the main exported oil meals.

5. Demand-Supply Gap

i. The ongoing trend of urbanization in developing countries, including India, is expected to alter dietary habits and traditional meals particularly. This shift will likely favour processed foods, generally high in edible oil content. OECD-FAO Agricultural Outlook (2023-2032) highlighted that India, the world's biggest vegetable oil importer, is projected to maintain its high import growth to satisfy growing domestic demand. The report further emphasized that the consumption of vegetable oils for food purposes is expected to account for 57% of the total globally, driven by a growing population and rising per capita consumption in lower and middle-income countries due to higher incomes and in emerging markets, the consumption of vegetable oil for food is set to reach levels comparable to those of wealthier economies.

ii. The ICAR-Indian Institute of Oilseeds Research survey revealed distinct regional preferences in edible oil consumption across India. Mustard oil reigned supreme in India's north (61%) and east (35%) zones, followed by sunflower oil. In the west zone, soybean oil held a slight edge (28%) over mustard (25%) and sunflower (25%) oils. The south zone presented a different picture, with sunflower oil (44%) dominating, followed by groundnut oil (29%). These variations likely reflect traditional culinary practices and locally available oilseeds. Additionally, the survey emphasizes the influence of dietary choices. Non-vegetarians, comprising 64% of respondents, consumed an average of 14.2 kg of oil per person annually, compared to the 12.6 kg average for vegetarians.

iii. Interestingly, the choice of edible oil varies between rural and urban areas. Mustard oil reigns supreme in rural sectors, accounting for approximately 45% of consumption. In contrast, urban areas favour refined oils, such as sunflower and soybean oil, which collectively hold a 47% share. This shift towards refined oils highlights substitutions from traditional options like vanaspati and groundnut oil.

iv. Over the years, there has been a significant increase in average Monthly Per Capita Consumption Expenditure (MPCE), indicating higher spending power and improved living standards. By 2022-23, the average MPCE in rural areas surged to `3,773; in urban areas, it reached `6,459. This substantial rise reflects improved purchasing capacity and quality of life, particularly in urban areas where the average MPCE is considerably higher.

v. Complementing the rise in MPCE, there has been a decline in the share of consumption of cereals in both rural and urban areas of India from 1999-00 to

2022-23. In 1999-00, cereals accounted for 22.23% and 12.39% of the average MPCE in rural and urban areas, respectively. However, by 2022-23, these figures dropped significantly to 4.91% in rural areas and 3.64% in urban areas. This decline suggests a shift in dietary patterns, possibly towards more diverse and processed food items.

vi. Congruently, the share of food items overall has declined. In 1999-00, food items constituted 59.4% and 48.06% of the average MPCE in rural and urban areas, respectively, while in 2022-23, food items constituted 46.38% in rural areas and 39.17% in urban areas. This trend indicates an evolving consumption pattern in India, with a growing preference for non-food items, possibly reflecting changes in lifestyle, income levels, and urbanization.

vii. Rural MPCE on edible oils witnessed a significant jump, rising from `18.2 to `135.5 during 1999-00 to 2022-23. Similarly, urban areas exhibited a substantial increase, with MPCE on edible oils increasing from ` 26.8 in 1999-00 to `153.1 by 2022-23.

viii. India's persistent demand for edible oil reveals a remarkable rise over six decades from a per capita consumption perspective. Between 1960-61 and 1980-81, consumption increased 1.2 times (from 3.2 kg/year in 1960-61 to 3.8 kg/ year in 1980-81). This growth accelerated further, reaching 2.2 times between 1980-81 and 2000-01 (from 3.8 kg/ year in 1980-81 to 8.2 kg/ year annum in 2000-01), and a staggering 2.4 times from 2000-01 to recent times (8.2 kg/ year in 2000-01 to 19.7 kg/ year in 2020-21). This rising demand can be attributed to many factors, including changes in income, lifestyle and evolving dietary patterns.

ix. India's oilseed production reached a new high of 41.35 MT in 2022-23, reflecting a significant increase of 3.39 MT compared to the previous year, i.e., 37.96 MT in 2021-22.The projected estimates of this study suggest a steady increase in major nine oilseeds production, reaching an estimated 43 MT by 2030 and 55 MT by 2047, up from 37.96 MT in 2021-22 in the Business as Usual (BAU) scenario. Forecasts of secondary sources of edible oil show a steady rise in production, with the aggregate reaching a projected nearly 5 MT by 2030 and 12.14 MT by 2047. This represents a significant increase from the 3.6 MT production level recorded in 2021-22.

x. The national-level edible oil supply is projected to reach 16 MT by 2030 and 26.7 MT by 2047 from 13.3 MT in 2021-22 in the BAU scenario.

xi. Based on the static / household demand approach, projected demand will reach 29.8 MT by 2030 and 32.6 MT by 2047. These projections indicate a persistent gap of 14.1 MT and 5.9 MT by 2030 and 2047, respectively. To bridge this critical gap, the edible oil supply must increase by 2.3 and 2.5 times the current supply by 2030 and 2047.

xii. Based on the normative approach, by 2030 and 2047, estimated demand is projected to be 15.87 MT and 17.35 MT, respectively. If the per capita consumption recommended by the ICMR-NIN is followed for edible oil consumption levels by 2047, India is projected to have a surplus of 0.13 MT and 9.35 MT by 2030 and 2047.

xiii. Given growing concerns about excessive edible oil consumption highlighted by organizations like the ICMR-NIN and the WHO, the behaviouristic approach adopts two forecast scenarios to explore potential future demand trends. Scenario-I aligns with the average consumption observed in developed countries (25.3 kg/person/year), while Scenario-II considers the highest consumption level, i.e., the United States (40.3 kg/person/year). It's important to note that these figures represent vegetable consumption in food only, excluding industrial usage.

xiv. In Scenario-I, by the year 2030 and 2047, the estimated edible oil demand is projected to be 38.3 MT and 41.9 MT, and the gap is projected to widen to 22.3 MT and 15.2 MT by 2030 and 2047, respectively. This scenario necessitates a significant increase in supply, by a factor of 2.9 and 3.2 times of the current supply by 2030 and 2047, respectively, to bridge the growing demand-supply gap.

xv. In Scenario-II, the demand is projected to be 45.5 MT by 2030 and 66.8 MT by 2047, and the gap is projected to widen further to 29.5 MT and 40 MT by 2030 and 2047, respectively. This scenario necessitates an even greater increase in supply, by a factor of 3.4 and 5 times the current supply by 2030 and 2047, respectively, to address the substantial demand-supply gap.

xvi. In the BAU situation, India's edible oil demand will reach Scenario-I by 2028 (i.e., 25.3 kg/person/year) and Scenario-II by 2038 (i.e., 40.3 kg/person/year). Under the high-income growth circumstance, assuming an estimated 8% annual per capita NNI growth, India's edible oil demand is expected to reach 25.3 kg/person/year (Scenario-I) as early as 2025. This represents a three-year advancement compared to the BAU situation. Furthermore, demand is projected to reach 40.3 kg/person/year (Scenario-II) by 2031, seven years earlier than anticipated in the BAU situation, showcasing even higher demand due to accelerated economic growth.

6. Strategies and Roadmap for Accelerating Growth in Edible Oil towards the Goal of *Atmanirbharta*

Increasing growth in the edible oil sector towards self-reliance involves a multifaceted strategy. The proposed strategy charted in this report is structured across three key pillars: (i) Crop Retention and Diversification, (ii) Horizontal Expansion, and (iii) Vertical Expansion. Horizontal Expansion Strategy aims to strategically increase the area dedicated to cultivating edible oil crops. This strategy seeks to bring more land under cultivation for specific oilseeds. Potential avenues for achieving this include rice fallow lands and highly suitable wastelands for transformation through palm cultivation and promoting crop retention and diversification in regions that currently focus on other agricultural crops. Vertical Expansion Strategy focuses on enhancing the yield of existing oilseed cultivation areas. This can be achieved through improved farming practices, better-quality seeds, and advanced production technologies.

i. The state-wise quadrant approach offers a valuable tool for achieving "Atmanirbharta" in edible oils. Identifying state clusters using four quadrants [i.e., (i) High Area-High Yield (HA-HY), (iii.) High Area-Low Yield (HA-LY), (iii) Low Area-High Yield (LA-HY), and (iv) Low Area-Low Yield (LA-LY)] for the edible oil crops cultivated in India. High Area is above the national average area cultivated for a specific oilseed crop, while Low Area is below the national average. High Yield is determined by exceeding the national average yield for that crop, whereas Low Yield falls below the national average yield.

ii. States with high cultivation area and yield (HA-HY) can focus on improving efficiency and adopting best practices from leading global producers. Conversely, states with high area but low yield (HA-LY) require interventions aimed at vertical expansion (i.e., enhancing yield). In low-area, high-yield states (LA-HY), the focus might shift towards horizontal expansion, expanding cultivation while maintaining efficiency. Finally, areas with low area and low yield (LA-LY) can focus on both horizontal and vertical expansion. They might necessitate a cost-benefit analysis to determine the viability of production compared to alternative crops.

iii. Despite some states falling under the high area-high yield quadrant for various oilseeds, their retention probabilities are surprisingly low. This pattern repeats across different oilseed crops and states.

iv. Rajasthan, Madhya Pradesh, and Haryana are in the high area-high yield quadrant for mustard, yet their retention probabilities are just 50%, 0%, and 62%, respectively. In contrast, despite its low area but high yield, Uttar Pradesh has a strong retention probability of 92%. Similarly, for soybean, Maharashtra boasts a high area and yield, but its retention rate is just 38%. On the other hand, Madhya Pradesh and Rajasthan have much higher retention rates of 72% despite lower yields.

v. In safflower cultivation, Karnataka falls under the high area-high yield quadrant but has a nil retention probability, whereas Maharashtra, with a lower yield, has a retention probability of 72%. Groundnut shows a similar trend, with Rajasthan having a 14% retention probability despite high area and yield. Andhra Pradesh and Karnataka, falling under the high area-low yield quadrant, have retention probabilities between 43% and 57%, while Madhya Pradesh and Maharashtra have 0% retention despite high areas.

vi. For sesamum, the area is above average in Uttar Pradesh and Madhya Pradesh, yet their retention probabilities are just 21% and 0%, respectively. Karnataka and Maharashtra fall under the high area-low yield quadrant in sunflowers, with retention probabilities of 50% and 38%, respectively. Lastly, for linseed, Uttar Pradesh and Madhya Pradesh are in the high area-high yield quadrant but have low retention probabilities of 21% and 0%, respectively.

vii. A detailed analysis of the horizontal and vertical expansion needed for edible crops in various states is listed in Chapter-V. States like Gujarat and Andhra Pradesh (except Rabi season), Karnataka, and Tamil Nadu stand out for their medium groundnut retention rates (43-64%). Conversely, lower retention rates in Gujarat (Rabi), Rajasthan, and Maharashtra suggest a need for targeted interventions to encourage continued groundnut cultivation.

viii. Madhya Pradesh and Rajasthan are at the forefront with high rates of soybean retention, signifying a continued interest in cultivating this crop. Conversely, Gujarat and Karnataka display lower retention rates, implying a higher likelihood of farmers adopting alternative crops. Maharashtra exhibits a low retention rate (38%), indicating a somewhat balanced inclination towards soybean cultivation.

ix. Uttar Pradesh takes the top spot with an exceptionally high retention rate (92%) for rapeseed and mustard, highlighting its dominant position in the state. Haryana and Rajasthan also demonstrate medium retention rates, suggesting a suitable environment for these crops. Gujarat exhibits a moderate level (40%), offering scope for further growth.

x. In cotton cultivation, Karnataka, Andhra Pradesh and Haryana emerges as leaders with medium retention rates, whereas Maharashtra exhibits low retention. Sunflower cultivation follows a similar trend, with Andhra Pradesh and Karnataka demonstrating medium retention. Maharashtra and Haryana, however, exhibit a lower retention of sunflowers. Safflower cultivation exhibits a notably high retention rate of 72% in Maharashtra, highlighting its economic importance. Conversely, Karnataka displayed the lowest retention rate for safflower.

xi. Strategically retaining oilseed crops and focusing on areas potentially lost to cereal cultivation could boost India's edible oil production by 20% in nine states, adding 7.36 MT of oilseeds and reducing import dependence by 14.2% (2.1 MT), thereby addressing the demand-supply gap.

xii. For soybeans, states like Madhya Pradesh and Rajasthan, with sizeable areas but low yields, require interventions to boost production efficiency. States with high yield potential but currently limited area, such as Karnataka, Telangana, Gujarat, Nagaland, Uttarakhand, Arunachal Pradesh, Meghalaya, Andhra Pradesh, Mizoram, Himachal Pradesh, could benefit significantly from focused efforts to expand soybean cultivation. Finally, states with low yield and limited acreage may need alternative agricultural strategies to improve their suitability for soybean production.

xiii. In Mustard, states like Gujarat, Punjab, and Telangana need horizontal expansion to capitalize on their high yield potential. Conversely, despite their high area, Uttar Pradesh, West Bengal, Jharkhand, and Assam require vertical expansion to increase yield. States with both low yield potential and limited area, including Bihar, Jammu and Kashmir, Chhattisgarh, Manipur, Arunachal Pradesh, Nagaland, Uttarakhand, Maharashtra, Meghalaya, Odisha, Himachal Pradesh, Tripura, Delhi, Sikkim, Andhra Pradesh, Karnataka, Mizoram, and Tamil Nadu, may require alternative agricultural strategies to increase yield and cultivation area.

xiv. In the case of groundnut, states with high areas but low yields, such as Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra, require interventions to boost productivity, learning from high-yielding groundnut-producing states within the country. Meanwhile, states with high yield potential but low area, such as Telangana, West Bengal, Punjab, Goa, and Puducherry, could explore opportunities to expand groundnut cultivation horizontally. Lastly, states with both low yield potential and limited acreage, including Uttar Pradesh, Odisha, Chhattisgarh, Jharkhand, Haryana, Tripura, Manipur, Uttarakhand, Nagaland, Arunachal Pradesh, Bihar, Kerala, and Himachal Pradesh, may require alternative agricultural strategies for improvement.

xv. For sesame crops, high cultivation areas but low yields, such as Madhya Pradesh, Uttar Pradesh, and Rajasthan, require interventions to increase yield, learning from high-yielding sesame-producing states within the country. Meanwhile, states with high yield potential but low area, such as Tamil Nadu, Karnataka, Telangana, Assam, and others, could explore opportunities to expand sesame cultivation. Lastly, states with low yield potential and limited area may need alternative agricultural strategies.

xvi. In Sunflower, states with high areas but low yields, such as Karnataka and Maharashtra, may require interventions for vertical expansion. Meanwhile, states with high yield potential but low areas, such as Haryana, Telangana, Bihar, West Bengal, Punjab, Uttar Pradesh, Gujarat, Madhya Pradesh, and Rajasthan, could explore opportunities to expand sunflower cultivation. Andhra Pradesh, Tamil Nadu, Nagaland, Arunachal Pradesh, Jharkhand, and Chhattisgarh have the potential to enhance both the cultivation area and the yield of sunflower crops.

xvii. In linseed, states like Jharkhand and Chhattisgarh have low yields despite substantial cultivation areas. Bihar, Rajasthan, Nagaland, Assam, Jammu and Kashmir, and Arunachal Pradesh have low areas despite significant yield. Meanwhile, states such as Odisha, Maharashtra, West Bengal, Karnataka, Himachal Pradesh, Meghalaya, and Tripura need horizontal and vertical expansion.

xviii. Niger seed cultivation in Chhattisgarh shows low yield despite having a substantial cultivation area. On the other hand, Assam, Andhra Pradesh, Jharkhand, Gujarat, and West Bengal exhibit low areas despite significantly higher yields, requiring horizontal expansion. Additionally, states such as Maharashtra and Karnataka demonstrate low yield potential and limited cultivation area.

xix. In the case of safflower, Maharashtra has a large area having low yield, requiring substantial efforts to improve it. On the other hand, states like Telangana, Madhya Pradesh, Arunachal Pradesh, West Bengal, and Bihar achieve high safflower yields despite having limited cultivation areas and needing horizontal expansion. Conversely, Jharkhand, Andhra Pradesh, Odisha, and Chhattisgarh need vertical and horizontal expansion.

xx. Amongst the secondary oil crops in cotton production, states like Punjab, Odisha, Andhra Pradesh, Madhya Pradesh, Karnataka, and Haryana have significant yields but low cultivation areas, indicating the need for horizontal expansion. Tamil Nadu, Meghalaya, and Chhattisgarh face challenges with both low yield potential and area. Additionally, efforts are needed to increase yield in Maharashtra, where there is high cultivation area but low yield.

xxi. West Bengal and Andhra Pradesh are earmarked for horizontal expansion for coconut cultivation. These states have notable yield potential but comparatively smaller cultivation areas, suggesting the possibility of expanding coconut cultivation across wider regions. Meanwhile, Kerala and Karnataka are highlighted for vertical expansion, indicating the need to increase productivity in the existing cultivation areas. Tripura, Bihar, Chhattisgarh, Nagaland, and Assam are identified for horizontal and vertical expansion, as they exhibit both low yield potential and limited cultivation area, requiring comprehensive strategies to boost coconut production.

xxii. Rice fallow areas across Indian states reveal a promising opportunity for horizontal expansion in oilseed cultivation. Utilizing one-third of the rice fallow area in ten states for oilseed cultivation could increase production by 3.12 MT and reduce import reliance by 7.1% (1.03 MT of edible oil), thereby addressing the demand-supply gap.

xxiii. Bridging the yield gap from 12% in castor to 96% in sunflower through widespread adoption of improved technologies and effective management practices could increase India's domestic oilseed production by 46% (17.4 MT). This would reduce edible oil imports by 25.7%.

xxiv. Optimizing seed utilization and processing capabilities are critical to strengthening the foundation for edible oil self-sufficiency. Studies indicate that high-quality seeds alone can contribute significantly (15-20%) to increased production, potentially reaching even higher levels (45%) when combined with efficient management of other agricultural inputs. However, the current Seed Replacement Ratio (SRR) falls short of the target of 80-85%, ranging from 25% in groundnut to 62% in rapeseed mustard, hindering overall yield improvement, as the National Seed Corporation highlighted.

xxv. The Indian vegetable oil sector is characterized by many small-scale, low-technology plants with substantial excess capacity, utilizing only 30% of its edible oil refining capacity. Modernizing existing mills and strategically investing in processing infrastructure will improve efficiency and minimise waste.

xxvi. Oil palm's significant yield advantage and efficient land utilization solidify its position as a strategic crop for boosting domestic edible oil production. Therefore, prioritizing horizontal expansion efforts for oil palm cultivation is crucial for India's journey towards self-sufficiency. Efforts should focus on capitalizing on the substantial untapped potential identified by ICAR-IIOPR in the 284 districts, which estimates an additional 2.43 Mha of land across India for oil palm cultivation. Furthermore, tactically utilizing two-thirds of the highly suitable areas of wastelands located in ICAR-IIOPR identified districts (i.e., 6.18 Mha) with the target of 0.34 Mha annually across the country for the next 18 years till 2042 presents a significant opportunity for further horizontal expansion. Highly suitable wastelands can be utilised through inclusive partnerships involving FPOs, FPCs, SHGs, etc., engaged on long-term contracts. A strategic approach combining horizontal and vertical expansion, leveraging the untapped potential to increase total edible oil production by 9.7 MT (from 2.43 Mha) and 24.7 MT from utilizing highly suitable areas of wastelands (i.e., 6.18 Mha) with a conventional yield assumption of 4 t/ha. Palm oil alone, through targeted expansion in these identified areas, can potentially increase a staggering 34.4 MT of edible oil, making a substantial stride towards closing the existing demand-supply gap.

xxvii. Rice bran, comprising 8.5% of total rice production with 17% oil content, offers an estimated potential of 1.9 MT of edible oil, with 0.85 MT currently untapped, translating to a potential 5.9% reduction in the demand-supply gap. Similarly, cottonseed presents a potential for an additional 1.4 MT of edible oil production, contributing to a further 9.7% reduction in India's edible oil demand-supply gap or import dependence.

xxviii. The strategies and interventions outlined in this report, encompassing horizontal and vertical expansion approaches, offer a vibrant path towards reducing import dependence. By implementing the strategic interventions, India has the potential to significantly increase domestic edible oil production to an estimated increase of 43.5 MT in edible oil production. This substantial increase has the potential to not only bridge the import gap but also position India on a trajectory towards self-sufficiency in edible oils.

xxviiii. By 2030 and 2047, the stated strategic interventions could achieve projected edible oil supplies of 36.2 MT and 70.2 MT, respectively, achieving self-sufficiency under the Normative and Household Approaches. These scenarios project a surplus in edible oil supply in both approaches by 20.3 MT and 52.8 MT under the Normative Approach and 6.1 MT and 37.6 MT under the Household Approach.

xxix. Behaviouristic Approach, which considers potential changes in food consumption patterns with rising incomes, offers a more nuanced perspective on India's future edible oil needs. Scenario-I, which assumes an average developed-world consumption level of 25.3 kg/person/year, projects a small import gap of 2.1 MT in 2030. However, this gap is projected to close entirely by 2047, with a surplus of 28.3 MT achievable. Scenario-II, based on the highest observed consumption level of 40.3 kg/person/year (i.e., United States), presents a more concerning picture in the near term. Under this scenario, a significant gap of 9.3 MT is projected by 2030. However, even this scenario suggests the potential for achieving self-sufficiency in the long term, with a projected surplus of 3.4 MT by 2047. These projections highlight the importance of increasing domestic production and considering potential shifts in consumption patterns when formulating long-term strategies for achieving edible oil self-sufficiency.

xxx. To bridge the potential import gap projected under the Behaviouristic Approach, particularly in the near term, the significant production increase envisioned through strategic interventions needs prioritized implementation. Realizing this ambitious target will necessitate a focused approach that leverages the "Quadrant Strategy" on a state-wise cluster basis. This data-driven strategy involves identifying and exploiting the potential opportunities within each state cluster for specific edible oil crops. It emphasizes a scalable approach that prioritizes clusters with LA-LY and those with HA-LY and LA-HY potential. By strategically targeting these clusters and implementing tailored interventions, India can maximize its production potential and effectively address the near-term challenges posed by potential consumption increases.

xxxi. Over the past five years (2016-17 to 2021-22), India's edible oil sector has witnessed a CAGR of about 3%. When considering a BAU scenario with current production levels maintained, this recent growth trend might be sufficient to meet the demand projected by the Normative Approach. It indicates that India could potentially meet its edible oil needs based on recommended intake levels if production continues on its current trajectory. However, achieving self-sufficiency in edible oils necessitates a more ambitious strategy. Under the Household Approach, which factors in population growth, to meet the projected demand by 2030, a significantly higher CAGR of 9.5% would be required during the 2021-2030 period. Even for the longer-term goal of self-sufficiency by 2047, a slightly elevated CAGR (3.5 %) from the existing CAGR would be necessary for 2021-2047.

xxxii. The Behaviouristic Approach introduces another layer of complexity by considering potential changes in consumption patterns driven by rising income levels, changes in lifestyles and dietary patterns, and prices. Scenario-I, representing an average developed-world consumption level, necessitates significantly steeper CAGRs to achieve self-sufficiency. In this scenario, CAGRs of 12.5% for 2021-2030 and 4.5% for 2021-2047 would be required to meet the projected demand by 2030 and 2037, respectively. Scenario-II, based on the highest observed consumption level, presents the most challenging scenario. Here, self-sufficiency by 2030 and 2047 necessitates even steeper CAGRs of 14.6% for the 2021-2030 period and 6.4% for the entire time period of 2021-2047. These findings highlight the critical need for strategic interventions to accelerate domestic production and bridge the gap between current growth trends and long-term self-sufficiency goals.

xxxiii. The potential gain in edible oil production estimated from the proposed strategic interventions combined with the existing production level, is anticipated to achieve self-sufficiency with the recent growth trend (CAGR of 3%) in all scenarios except for the most demanding scenario (i.e., Behaviouristic Approach Scenario-II based on the highest observed consumption level) in the near term. To meet the projected demand by the more immediate target of 2030 under this scenario, a CAGR of 5.2% would be required for the 2021-2030 period, representing a 2.2% increase from the recent growth situation. This targeted increase can be achieved through a more focused, rigorous implementation and intensive approach.

7. Recommendations and Way Forward

The insights gained from the farmer's survey, coupled with a comprehensive strategy and roadmap outlined in the previous chapter, the following recommendations are presented.

i. Crop Clusters and Technology Customization:

Crop-wise clustering integrates horizontal and vertical expansion efforts for targeted growth. States are categorized into four clusters (HA-HY, HA-LY, LA-HY, and LA-LY) based on area and yield performance for each oilseed crop, enabling nuanced growth strategies (see Chapter-V for detailed lists). The customized cluster technology needs to be developed to improve yield and establish Agro-Ecological Sub Region (AESR)-based crop-specific model farms to facilitate the horizontal spread of advanced technologies.

ii. Horizontal expansion in Rice fallow:

Utilizing one-third of the total Rabi rice fallow area across ten states for oilseed cultivation has the potential production of an additional 1.03 MT, representing a significant 7.1% reduction in India's import reliance. To ensure the economic viability and large-scale implementation of this strategy across the potential states, exploring the economic feasibility of large-scale cultivation and identifying the optimal crop selection for different states is critical.

iii. **Enhancing oilseed development in Bundelkhand and the Indo-Gangetic Plain**

Revitalizing the Bundelkhand region in Madhya Pradesh and Uttar Pradesh, which is suitable for oilseed cultivation, is crucial. Prioritizing technology interventions, especially promoting sesame cultivation tailored to the region's conditions, can significantly boost farm incomes. Additionally, diversifying the rice-wheat cropping system in the Indo-Gangetic Plain (IGP) by introducing soybean, rapeseed-mustard, and sunflower in selected agro-ecological regions offers farmers increased profitability, addressing groundwater depletion and soil health degradation issues.

iv. **Prioritizing Wasteland Utilization for Oil Palm Horizontal Expansion**

Prioritizing a strategic approach to horizontal expansion of oil palm cultivation, leveraging highly suitable underutilized wastelands is recommended. This strategy can be fostered through inclusive partnerships involving FPOs, FPCs, SHGs, etc., engaged in long-term contracts. Specifically, utilizing two-thirds of the total highly suitable areas of wastelands located in ICAR-IIOPR identified districts (i.e., 6.18 Mha) presents a significant opportunity for large-scale expansion. This approach has the potential to increase total edible oil production by an estimated 24.7 MT, making a significant stride towards closing the existing demand-supply gap and reducing dependence on imports.

v. **Cluster-Based Seed Village**:

Establish cluster-based seed hubs at block levels, such as “One Block-One Seed Village,” to supply high-quality seeds for oilseeds aiming to enhance seed replacement rate (SRR) and varietal replacement rate (VRR). Setting up a resilient system for these hubs will guarantee farmers access to high-quality oilseeds through Farmers’ Producer Organizations (FPOs)/ Self Help Groups / FPC promptly.

vi. **Promotion of Bio-fortified Oilseed Varieties:**

Biofortification must be part of the national oil missions to address micronutrient malnutrition by enhancing oleic acid in groundnut and soybean, linoleic acid in linseed, and reducing anti-nutritional factors like erucic acid and glucosinolates in mustard, and trypsin inhibitor and lipoxygenase in soybean. ICAR has released 14 oilseed varieties (mustard-6, soybean- 5, linseed-1, groundnut-2). Research institutions should produce more breeder seeds and provide them to state governments, aiming for a 10-12% annual adoption rate of bio-fortified varieties by farmers.

vii. **State-Level Seed Rolling Plans and Harmonizing Seed Quality Standards:**

State governments are crucial in initiating breeder seed production through indent requests. States should develop five-year seed rolling plans to ensure access to improved varieties. These plans prioritize replacing outdated oilseed varieties with high-yielding, bio-fortified, and disease-resistant alternatives. Harmonizing Indian Minimum Seed Certification Standards (IMSCS) with the Economic Co-operation and Development (OECD) and the International Seed Testing Association (ISTA) standards ensures that Indian oilseeds meet global quality requirements, facilitating international trade opportunities.

viii. **Adoption of Newly Bred Indian Oilseed Varieties:**

Existing technologies present significant opportunities to enhance oilseed yields, with newly developed ICAR varieties showing genetic potential comparable to leading global producers. This potential ranges from 3.5-4.0 t/ha for groundnut, 3.0-3.5 t/ha for mustard, 2.2-2.8 t/ha in soybean, 2.0-2.5 t/ha in sunflower, 1.0-1.2 t/ha in safflower, 1.2-1.6 t/ha in linseed, and 1.0-1.5 t/ha in sesame, highlights the importance of scaling up production and widespread distribution of these improved varieties. The up-gradation of technology in oilseeds is crucial for achieving these yield improvements.

ix. **Adoption of Improved and Advanced Production Technologies**:

Bridging the yield gap, which ranges from 12% in castor to 96% in sunflower, technology improvements can raise national oilseed production by 46%, resulting in approximately a 26% decrease in import reliance. Crop improvement strategies should prioritize maximizing genetic potential by integrating conventional breeding techniques with modern biotechnological tools. Specifically, a focused approach on heterosis breeding to exploit hybrid vigour is essential for crops like sunflower, castor, rapeseed-mustard, safflower, and sesame.

x. **Harnessing Rice Bran Oil for Domestic Blending:**

The rice bran industry offers substantial potential for domestic edible oil production, capable of yielding nearly a million tons of oil suitable for blending with popular cooking oils. Collaboration with other major rice-producing countries is essential to standardizing regulations for rice bran oil under the Codex Committee on Fats and Oils of the Joint WHO-FAO Food Standards Program, facilitating its large-scale utilization.

xi. **Enhancing Efficiency in the Solvent Extraction Industry:**

The solvent extraction industry, despite rapid expansion, faces challenges due to low-capacity utilization (around 30%), which requires addressing geographical imbalances in plant distribution and promoting modernization. Optimizing oil extraction through enhanced mill management practices is essential to achieve at least 60% annual capacity utilization for increased efficiency in domestic edible oil production.

xii. **Optimizing Storage Strategies and Price Incentives:**

Balancing off-season storage profitability with consumer affordability is key. Implementing fair pricing structures ensures adequate margins for storage costs, interest, and stakeholder returns, promoting market stability while incentivizing off-season sales.

xiii. **Enhancing Marketing Infrastructure:**

To improve the realizable income of oilseed farmers, ensuring procurement at the Minimum Support Price (MSP) through NAFED (National Agricultural Cooperative Marketing Federation of India) and state-owned oilseed federations is essential.

Furthermore, facilitating direct marketing of output with NAFED/state-owned oilseed federations can act as a catalyst for promoting oilseed cultivation in non-traditional areas of the country.

xiv. **Setting Up Testing Laboratories in the Mandis:**

Indian oilseed markets lack a scientific approach, with traders relying solely on visual inspection. This subjectivity leads to inconsistencies in pricing and disadvantages producers of higher-quality oilseeds. Establishing standardized quality parameters and implementing mandatory testing procedures at mandis (agricultural markets) is vital to address this gap. Testing laboratories may be set up in PPP mode utilizing the expertise of agricultural universities and ICAR institutions.

xv. **Enhancing Oil Palm Sector Efficiency:**

Promoting large-scale "captive plantations" and dedicated oil palm "seed gardens" is crucial to boost domestic edible oil production. Declaring oil palm as a plantation crop would streamline regulations and facilitate land allocation. Additionally, enforcing zero-waste policies in processing units ensures byproducts are utilized, potentially converting palm oil mill effluent (POME) into methane for electricity generation and supporting value-added enterprises.

xvi. **Strategic Partnerships for Sustainable Edible Oil Production:**

Leveraging public-private partnerships is crucial for accelerating edible oil production, utilizing private sector expertise in technology, marketing, seed production, and area promotion across all oilseed crops, including oil palm, with buy-back arrangements. Achieving sustainable oil palm production requires collaboration among government agencies, grower cooperatives, local NGOs, and the private sector, utilizing initiatives like the Roundtable on Sustainable Palm Oil (RSPO) to prioritize biodiversity conservation.

xvii. **Dynamic Trade Policy for Balanced Growth:**

A flexible tariff structure, responsive to global market prices, domestic supply and demand trends, and the Minimum Support Price (MSP) for oilseeds, offers a strategic approach. Furthermore, to bolster the domestic refining industry in the face of rising refined oil imports, a 10-15% increase in the duty differential between crude and refined oils is recommended, as suggested by the CACP (2023).

xviii. **Broadening the Scope of the National Mission on Edible Oils:**

Expanding the National Mission on Edible Oils is recommended to achieve self-sufficiency in edible oils and reduce import dependence. This broadened initiative should encompass key oilseeds like mustard, soybean, groundnut, sunflower and sesame. Additionally, exploring the potential of secondary and tree-based oilseed varieties can further diversify domestic production and enhance overall edible oil security.

xix. **Public Education on Dietary Guidelines:**

Encouraging greater use of domestically produced edible oils in the food industry is crucial for strengthening the domestic edible oil sector. Introducing incentive schemes that reward food manufacturers for integrating locally sourced and processed oils into their products has the potential to generate substantial economic benefits.

To foster consumer acceptance of domestically produced edible oils, strategies include culinary workshops targeting chefs, homemakers, influencers leveraging cooking shows to highlight versatility, and public education emphasizing the Recommended Dietary Allowance (RDA) of fats and oils, as established by the WHO and NIN, are crucial. These initiatives support SDG-3 (Good Health and Well-Being), along with the importance of understanding the financial implications of health expenditures which aims to reduce catastrophic health spending and ensure affordable access to health needs, including nutrition.

xx. **Data-Driven Transformation and Research Investment:**

Addressing disparities in oilseed yields requires a data-driven approach and robust systems to bridge regional gaps. Investing in research and development is crucial for transforming the edible oil sector, offering higher returns than input subsidies.

CHAPTER-I

INTRODUCTION

INTRODUCTION

1.1 Background

India's edible vegetable oil sector is a significant player on the global stage, ranking fourth behind the USA, China, and Brazil; it contributes a substantial share to the global picture, accounting for roughly 15-20% of the global oilseed area, 6-7% of vegetable oil production, and 9-10% of total consumption. Within the Indian agricultural sector, oilseeds hold the second-highest acreage, production, and economic value, surpassed only by food grains (NABARD, 2020). India's diverse agroecological conditions enable the cultivation of nine annual oilseed crops, including groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower, niger, castor and linseed. However, a major challenge lies in the rainfed area, which contributes 76% of the oilseed cultivation area and around 80% of total production. These rainfed regions are particularly susceptible to environmental challenges like erratic weather patterns such as potential El-Nino events and heat waves, jeopardizing overall production stability. This vulnerability poses a significant risk to overall production stability, necessitating the development and implementation of strategies to enhance crop resilience in the face of these environmental threats.

Oilseeds account for 14.3% of the yearly gross cropped area in India. India ranks first in the production of castor, safflower, sesame and niger, second in groundnut, third in rapeseed-mustard, fourth in linseed, and fifth in soybean. Rajasthan, Madhya Pradesh, Gujarat, and Maharashtra are the major oilseed-producing states, contributing to more than 77% of the total oil-seed production in the country. Oilseeds contribute 12-13% to the dietary energy and account for about 8% of the agricultural exports. Among nine major oilseeds, soybean (34%), rapeseed & mustard (31%) and groundnut (27%) contribute to more than 92% of total oilseeds production in the country. However, the major contribution to domestic edible oil production comes from rapeseed-mustard (45%), groundnut (25%) and soybean (25%). The minor edible oilseeds (sesame, sunflower, safflower, and niger) contribute about 5% of the total domestic production. India's oilseed production reached a new high of 41.35 million tonnes (MT) in 2022-23, reflecting a significant increase of 3.39 MT compared to the previous year (PIB, 2023). While primary oilseeds contribute approximately 8.97 MT, secondary sources like cottonseed, palm oil, rice bran, coconut, solvent-extracted oils, and tree-borne oilseeds (TBOs) add another 3.6 MT. However, despite this positive growth, the country still falls short of meeting domestic demand.

India is heavily dependent on imports to meet its edible oil requirements and is the world's largest importer of vegetable oils, followed by China and the USA. As per the Directorate of Vanaspati, Veg Oils and Fats, India imported 14.2 MT of edible oils in 2021-22 and surged to 16.5 MT during 2022-23, driven by the low 5.5% duty on crude palm oil, soybean oil and sunflower oil (SEA, 2023). Over the past five decades, the share of imports has increased considerably, from 3% in 1970-71 to 57%. This dependency on edible oil is negatively impacting the country's FOREX (i.e., Foreign Exchange) by 20.56 billion USD, making it more important for the nation to become self-sufficient (Atmanirbharta) in the production of edible oil through the promotion of oilseeds and palm oil. Of all the imported edible oils, the share of palm oil is about 57%, followed by soybean oil (29%) and sunflower (14%).

Demand for edible oils has been increasing faster than production due to population growth, rapid urbanization, sustained rise in per capita income, and changing lifestyles and dietary patterns. In India, per capita consumption of edible oil has witnessed a dramatic rise, increasing from 3.2 kg/annum in 1960-61 to 3.8 kg/annum in 1980-81, 8.2 kg/annum in 2000-01, 15.8 kg/annum in 2012-13, and 19.7 kg/annum (Directorate of Vanaspati, Veg Oils and Fats, 2021-22) recently. The demand for edible oil increased at a rate of 4.3%, while production of oilseeds grew at the rate of 2.2%, necessitating the import of edible oil.

India's heavy dependence on edible oil imports necessitates a multifaceted strategy to achieve self-sufficiency (Atmanirbharta) and alleviate the strain on the trade balance and financial resources. Leveraging fallow rice land and cultivable waste land for cultivation can significantly expand the area under oilseed production. Simultaneously, implementing improved and advanced agricultural technologies, such as high-yielding seed varieties, robust seed traceability, seed village and quality assurance systems creation, and precision farming techniques, can optimize yields and resource utilization. Encouraging value addition through domestic processing and refining of oilseeds will not only enhance economic returns for farmers but also reduce dependence on imported finished products. Well-organized crop management practices, including combining Integrated Nutrient Management (INM) and Integrated Pest Management (IPM), are crucial for optimizing plant health and minimizing yield losses. Strategic crop diversification focused on high-yielding oilseeds and retaining existing cultivated areas will promote production diversity and long-term sustainability. Developing efficient marketing and market linkages for domestic oilseeds will streamline the value chain and ensure fair returns for farmers. Furthermore, strong public-private partnerships can leverage private sector expertise and resources to accelerate technological advancements and infrastructure development in the edible oil sector. Finally, implementing dynamic trade policies prioritising domestic production and discouraging unnecessary imports can create a supportive environment fostering domestic edible oil production. This approach mitigates import dependence, empowers rural communities, and strengthens the agricultural sector.

1.2 Rationale for Atmanirbharta in Edible Oil

"Atmanirbharta," the Hindi term for self-reliance or self-sufficiency, has become a guiding principle for Indian government policies, aiming to minimize dependence on imports and empower the nation to meet its domestic needs. This pursuit of self-sufficiency holds immense strategic value for economic advancement, food security, and cultural heritage preservation. It is pivotal for the transformation of a country into a developed nation. Achieving Atmanirbharta in edible oil, a critical sector within agriculture promises a multifaceted benefit: it strengthens the national infrastructure, fosters domestic production and innovation, and bolsters the production capacity to meet future demands, ultimately contributing to a sustained rise in living standards. Additionally, edible oils are fundamental in diverse Indian cuisines and deeply rooted in tradition. By prioritizing Atmanirbharta in this sector, India can also safeguard its rich culinary heritage, empower rural communities, and create employment opportunities. Therefore, pursuing Atmanirbharta in edible oil is not merely an economic goal but a strategic imperative for a self-reliant and prosperous India.

In the motion of thanks on the President's address to Parliament in Rajya Sabha on February 7, 2024, The Hon'ble Prime Minister, Shri Narendra Modi, emphasized India's commitment to self-reliance in edible oil production. Hon'ble Prime Minister declared, "As Prime Minister, I reaffirm India's belief in becoming Atmanirbhar in edible oil production. We call India a "Krishi Pradhan Desh", but today, we still import crores of rupees of edible oil. I have full confidence in the farmers of my country and the policies we have in place. We can achieve self-sufficiency in the next five years."

Achieving self-reliance (Atmanirbharta) in the edible oil sector holds immense strategic importance for India, encompassing several critical aspects:

1.2.1 Minimizing Import Dependency

Over the years post 2011-12, India has seen an exponential increase in the import of edible oils. The accelerating demand of domestic consumers has surpassed the supply capacity of domestic consumers by a great amount. This overdependence exposes India to various vulnerabilities, including volatile prices, market fluctuations, and potential supply disruptions, impacting national security and economic stability. The path of self-reliance minimizes risks caused by external factors along with unnecessary economic and political dependence on other nations. During the year 2021-22, a Centrally Sponsored Scheme, namely, National Mission on Edible Oil-Oil Palm (NMEO-OP), has been launched to promote oil palm cultivation for making the country "Atmanirbhar" in edible oils with a particular focus on North Eastern States and Andaman & Nicobar by increasing area of Oil Palm from 3.70 lakh hectares (Lha) to 10.00 Lha in 2025-26 in 15 States / UTs.

1.2.2 Achieving Nutritional Security

In the Indian context, achieving nutrition security is deeply intertwined with the health and sustainability of the edible oils industry. Edible oils not only form an essential component of diverse culinary traditions across the nation but also play a critical role in nutritional well-being. They serve as a primary source of dietary fats and essential fatty acids like omega-3 and omega-6, offering vital nutrients such as vitamins and antioxidants. Consumed in moderation, edible oils contribute to a balanced and varied diet, enhancing food palatability while enabling the absorption of fat-soluble vitamins like A, D, E, and K. Therefore, ensuring sufficient and consistent access to safe and nutritious edible oils becomes paramount for guaranteeing nutrition security for the Indian population. This necessitates focusing on strategies that bolster domestic production, improve supply chain efficiency, and promote responsible consumption practices. Only through a multi-pronged approach, edible oils remain readily available and valuable contributors to a secure and healthier India.

1.2.3 Enhancing Economic Development

Achieving self-sufficiency in edible oils offers significant economic advantages for India. Firstly, it creates a closed-loop system where a substantial portion of the industry's generated wealth remains within the country. This is evident in Indonesia, where the palm oil sector contributes a staggering 3-4% to its GDP, showcasing the potential for domestic economic growth. Additionally, Atmanirbharta generates substantial foreign exchange savings by reducing dependence on imports. For India, this translates to a reduced need for significant edible oil imports, positively impacting its balance of payments and overall financial stability. This is crucial as the edible oil sector; a pivotal economic component directly influences the nation's GDP. Furthermore, Atmanirbharta fosters the growth of the domestic processing industry, creating a value chain that extends beyond primary production. This includes establishing oil extraction mills, refining units, and packaging facilities, each adding value to the raw produce. This downstream industry generates additional employment opportunities and contributes further to economic development. For example, processing units for groundnut, soybean, palm oil, etc., can create significant value addition and employment, benefiting rural and urban communities.

Given the multifaceted benefits of Atmanirbharta in the edible oil sector, it is imperative to address existing challenges and identify effective strategies for growth. Therefore, the terms of reference for "Pathways and Strategy for Accelerating Growth in Edible Oil towards Goal of Atmanirbharta" are essential to chart a roadmap for achieving this crucial national objective.

Terms of Reference:

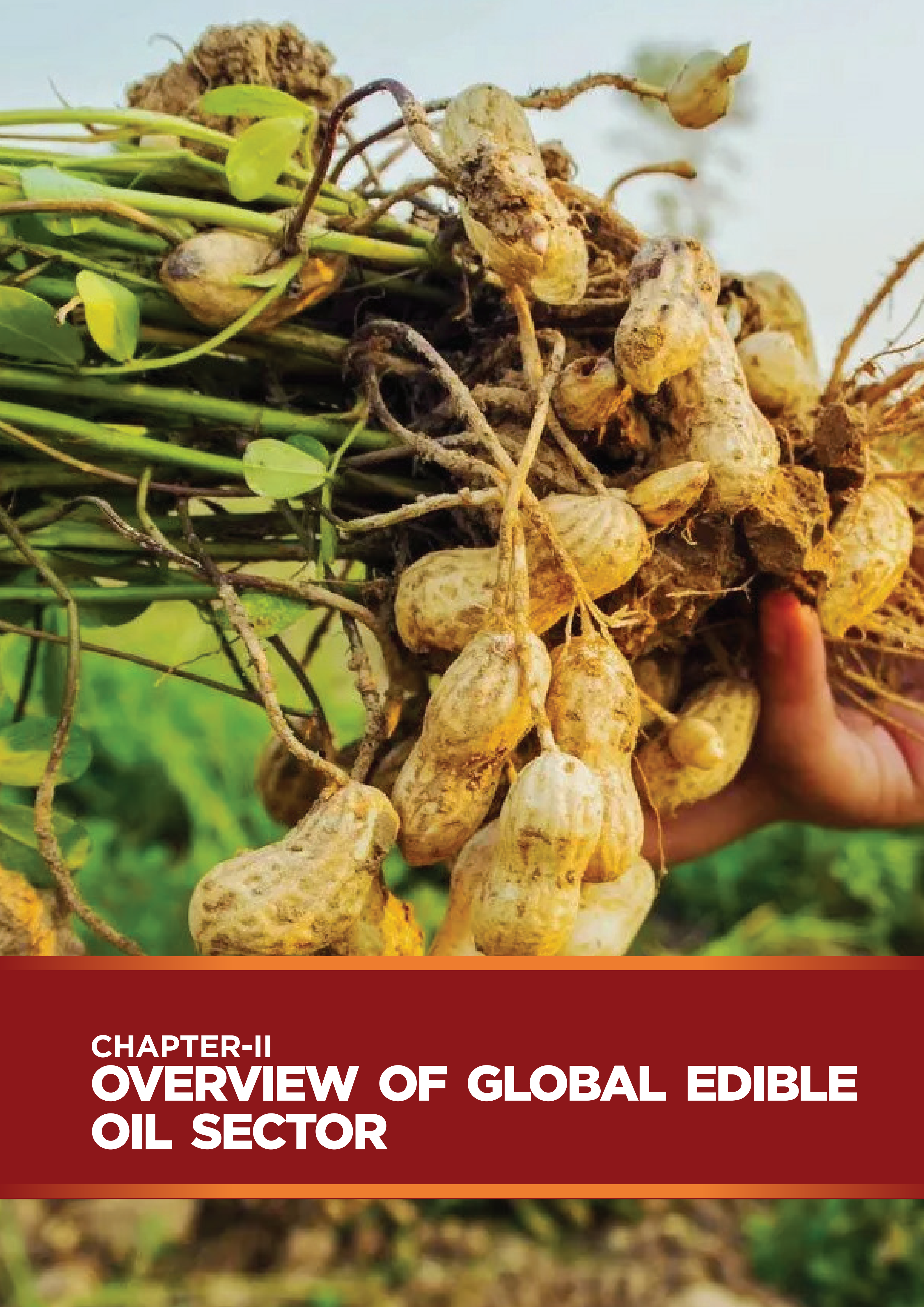
i. To analyse the performance of the edible oil sector in India by examining trends in area, production and yield of major oilseeds in India and the world.

ii. To examine the trends in the import and export of the edible oil sector.

iii. To discuss the gap between demand and supply of total and major edible oils in the country.

iv. To assess the past strategies to achieve self-reliance in the edible oil economy.

v. To develop new strategies & suggest a roadmap to achieve Atmanirbharta in edible oils.

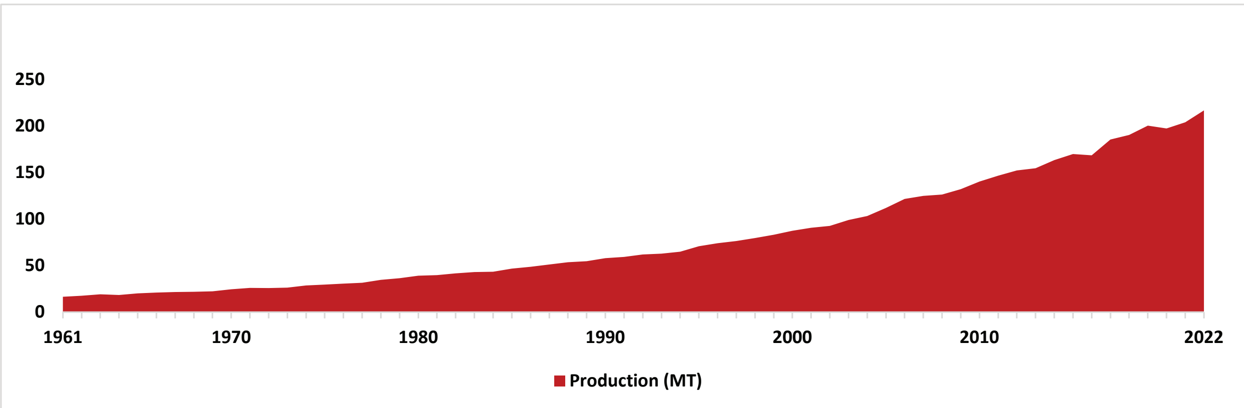


CHAPTER-II

OVERVIEW OF GLOBAL EDIBLE OIL SECTOR

GLOBAL EDIBLE OIL SECTOR: AN OVERVIEW

Edible oils are mainly vegetable oils that are subjected to several processes to remove undesirable constituents. To make them suitable for human consumption, most edible oils are subjected to refining processes, such as neutralization, bleaching and deodorization. Regarding consumption as a food product, vegetable oils are considered the healthier alternative as they contain more unsaturated fatty acids than animal fats. The global economy for edible vegetable oils has witnessed consistent growth over the years, with projections for 2024-25 indicating a 2% increase in production to reach 228 MT[3]. This growth is expected to be driven by major gains in soybean, palm, and rapeseed oil production, with sunflower seed oil production also showing modest growth (USDA, 2024) (Figure 2.1).



***Source:** FOASTAT Database (2023)*

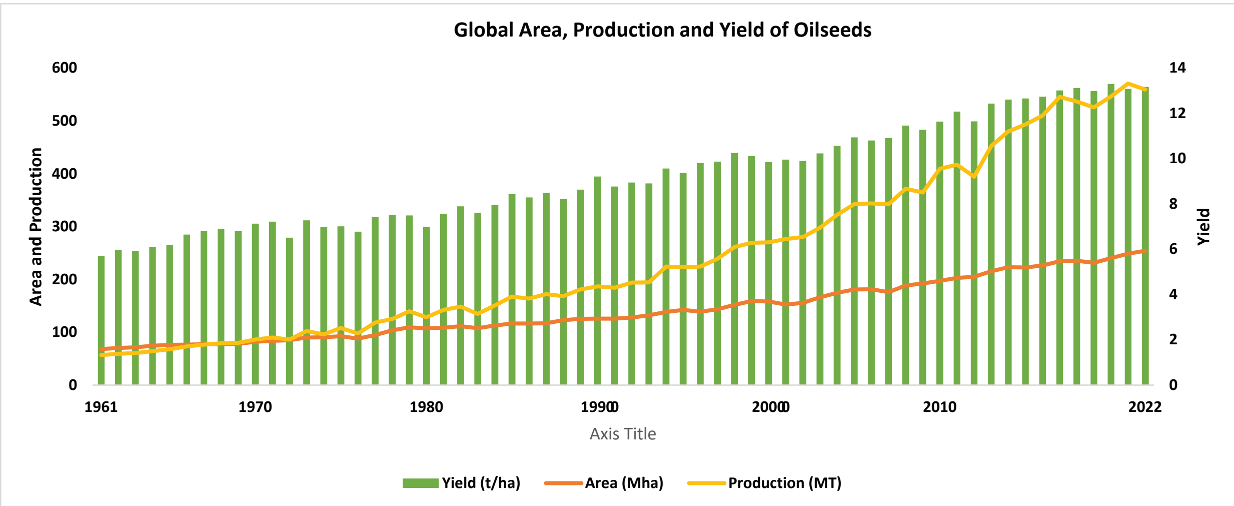
Figure 2.1: Global production of vegetable oils (1961- 2022)

2.1 Global Area, Production, and Yield Trends of Oilseeds

Globally, oilseeds rank fourth behind cereals, vegetables & melons, and fruits & nuts (OECD-FAO, 2020), occupying 254 Mha of global arable land (FAOSTAT, 2022). While about 40 oilseed crops are consumed worldwide, few hold commercial importance. These crops are primarily grown for their oil content, used in cooking, industrial applications, and, increasingly, in producing biofuels. These oilseed production and consumption significantly impact global food security, trade, and economic stability. Therefore, understanding the trends and dynamics of the oilseed sector is crucial.

3. FAOSTAT data consists of coconut oil, cottonseed oil, groundnut oil, linseed oil, sesame seed oil, olive oil, palm oil, rapeseed oil, safflower seed oil, soybean oil, and sunflower seed oil.

Global oilseed production has witnessed a remarkable expansion over the past six decades. According to FAOSTAT (2022), global output for the nine major oilseeds (i.e., groundnut, linseed, mustard, rapeseed, safflower, sunflower, sesame, soybean, and castor) reached nearly 559 MT in FY 2022-23. Figure 2.2 visually depicts this impressive growth trajectory. Since 1961, global oilseed production has increased nearly tenfold, rising steadily from 57.02 MT. This significant trend underscores the growing importance of oilseeds in the global agricultural landscape. While the area under oilseed cultivation has demonstrably expanded, production has grown much faster. This highlights advancements in farming practices, with global oilseed yield doubling from 5.7 t/ha in 1961 to 13.16 t/ha in 2022-23, reflecting increasing efficiency in oilseed production. However, despite this growth, the world population has also grown by 1.5% over the same period. This expansion in population directly contributes to the rise in global oilseed consumption. Consequently, continued advancements in production efficiency are crucial to meet this growing demand. In this context, for nations like India, with a large and expanding population, domestic oilseed production holds strategic importance for bolstering national food security, reducing dependence on volatile import markets and ensuring greater self-sufficiency in the edible oil sector.



Source: FOASTAT Database, 2023

Figure 2.2: Global area, production & yield of oilseeds (1961 - 2022)

Further, according to the USDA global market analysis report (2024), global oilseed production in 2024-25 is expected to reach a record high of 687 MT, marking a 4% increase from the 2023-24 marketing year. This growth is primarily driven by increased soybean production in South America and the United States. Worldwide soybean output is anticipated to rise by over 25 MT (more than 6%), reaching 422 MT. Global rapeseed production is projected to remain relatively stable, with gains in Canada, Australia, and China balancing out declines in the European Union, Ukraine, and India. World sunflower seed production is forecast to grow, with increases in Ukraine and the European Union slightly surpassing decreases in Argentina and Russia. Production of other oilseeds, such as cottonseed, peanuts, and palm kernel seeds, is also expected to grow slightly, while copra production is predicted to decline.

2.2 Growth Trends in Oilseeds and Vegetable Oils Production

An analysis of compound annual growth rates (CAGR) from 1961 to 2022 reveals interesting trends in oilseeds and vegetable oils production (Table 2.1). The initial two decades (1961-1980) witnessed a significant rise, with oilseeds leading the way at a CAGR of 4.6%, while vegetable oils grew at a slightly lower rate of 4.3%. Over the subsequent two decades (1981-2000), oilseed growth declined to a CAGR of 3.6%, while vegetable oils remained relatively stable at 4.2%. Despite fluctuations, both sectors saw modest recoveries in the early 21st century. Overall, spanning the entire period from 1961 to 2022, vegetable oils outpaced oilseeds with a CAGR of 4.4% compared to oilseeds' 3.9% growth. The growth rate of vegetable oils has indeed been surpassing that of oilseeds over the past three decades due to the inclusion of palm oil, olive oil, coconut oil, and cottonseed oil, which are not traditionally classified under oilseeds and led to vegetable oils outpacing oilseeds in growth.

Table 2.1: CAGR for Oilseeds and Vegetable Oils (1961 - 2022)

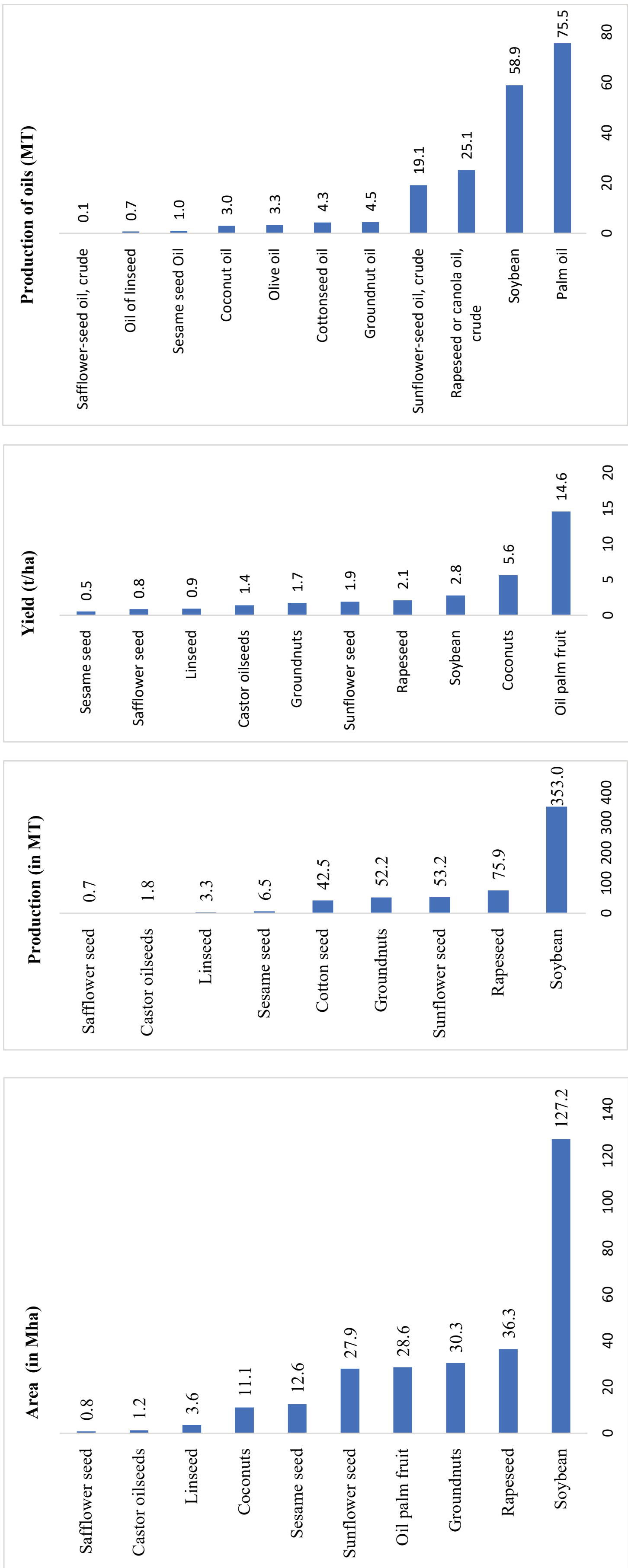
CAGR during 1961 - 2022 (%)		
Years	**Oilseeds**	**Vegetable Oils**
1961-1980	4.6	4.3
1981-2000	3.6	4.2
2001-2020	3.9	4.3
1961-2022	3.9	4.4

Source: *Author's computation*

2.3 Global Oilseed and Edible Vegetable Oil Scenario

A review of global oilseed statistics from 2017-18 to 2022-23 reveals soybean's clear dominance (Figure 2.3). With an average cultivated area of 127.2 Mha, it significantly surpasses other oilseeds, followed by rapeseed (36.3 Mha) and groundnut (30.3 Mha). This dominance extends to global production, where soybean accounted for nearly 60% of the total output over the past six years, with an average production of 353 MT. This reflects the high demand for soybeans and their superior productivity, with an average global yield of 2.8 t/ha over the past six years. Furthermore, the average cultivation area and productivity of soybean have seen an upward trend in recent years, highlighting its increasing global importance. Rapeseed (75.9 MT), sunflower seed (53.2 MT), and groundnut (52.2 MT) follow soybean in terms of production, with average yields of 2.1 t/ha, 1.9 t/ha and 1.7 t/ha, respectively. Notably, oil palm fruit boasts the highest average yield (14.6 t/ha) over the past six years, followed by coconuts in the shell (5.61 t/ha).

While soybean dominates the oilseed landscape, palm oil emerges as the frontrunner in global edible vegetable oil production (Figure 2.3). Palm oil dominates the global edible oil market with an average annual production volume of 75.5 MT. Soybean oil follows closely behind, maintaining a robust production average of 58.9 MT, reflecting its widespread use in culinary and industrial applications. Rapeseed or canola oil, with an average production of 25.1 MT, and sunflower oil at 19.1 MT, secure third and fourth positions in the global edible vegetable oil production hierarchy. This production profile highlights the significance of these oils in the global food supply chain.



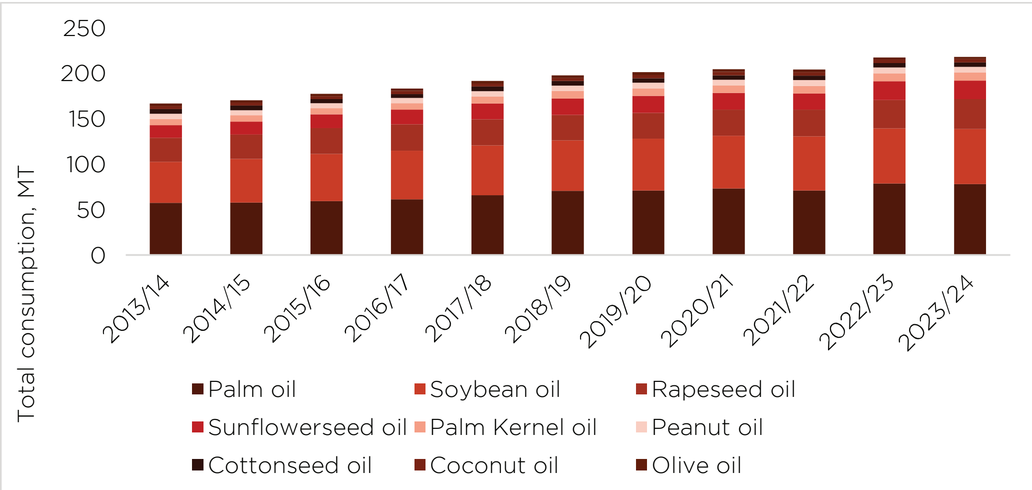
Source: Authors computation from FOASTAT Database

Figure 2.3: World area, production and productivity of major edible vegetable oil crops (2017-18 to 2022-23)

2.4. Global Vegetable Oil Consumption: Rising Demand and Shifting Preferences

Several factors propel the global consumption of vegetable oils, including population growth, urbanization, income levels, and dietary shifts. As populations in developing countries expand and experience economic growth, the demand for vegetable oils is projected to climb. Additionally, evolving consumer preferences towards healthier options and sustainable sourcing practices shape consumption patterns.

Palm oil leads global vegetable oil consumption with a significant 77.99 MT annually (Figure 2.4). Soybean oil, a versatile choice for cooking and food processing, follows closely behind at 60.72 MT. Rapeseed oil (canola oil) has witnessed a steady rise to 32.82 MT in 2022-23, while sunflower seed oil, valued for its light flavour and high smoke point, reached 20.27 MT in the same period. While consumption across different oil types fluctuates, the overall trend suggests a growing global appetite for vegetable oils. Looking ahead, the USDA's 2024 global market analysis report projects nearly 3% growth in vegetable oil consumption for food purposes, with significant gains anticipated for soybean and palm oil and modest increases for rapeseed oil. Sunflower seed oil consumption is expected to contract slightly. The report identifies China and India as the primary drivers of this growth, with the European Union maintaining relatively stable usage. The report further highlights the United States, Indonesia, and Brazil as the leading forces behind the projected rise in global industrial consumption of vegetable oils.



Source: Statista; US Department of Agriculture (USDA), 2024

Figure 2.4: Consumption of vegetable oils worldwide from 2013-14 to 2023-2024, by oil type (in MT)

2.5 India: A Major Player in the Global Edible Oil Market

India, the 5th largest economy globally, holds a prestigious position among the leading global producers of oilseeds and edible oils (Table 2.2). India cultivates a wide range of oilseed crops, including groundnut, soybean, rapeseed, mustard, sesame, safflower, linseed, niger seed, sunflower and castor. It emerges as a significant player across various global edible oilseeds and oils market segments. Holding the top position in rice bran oil production

(46.8% of global market share), India demonstrates clear dominance in this category. Similarly, castor seed production sees India firmly in the lead with an impressive 88.48% global share. The country is second in cottonseed oil production (28.41% share), following China. For groundnut seeds (excluding shelled) and groundnut oil, India again ranks second with shares of 18.69% and 16.34%, respectively, trailing China and the USA. In addition to that same seed and safflower seed crude oil production, India ranks second in 18.43% of the total, respectively, behind Sudan and the USA.

Table 2.2: India's position in the global edible oil production market (2022-23)

Edible Oil Crop	India's Rank	Share in world production (%)	Next to
Groundnuts, excluding shelled	2nd	18.69	China
Groundnut Oil	2nd	16.34	China (2021)
Soybean	5th	3.72	Brazil, USA, Argentina, China
Soybean Oil	5th	2.14	China, USA, Brazil, Argentina (2021)
Castor Seed	1st	88.48	NA
Rapeseed	3rd	13.72	Canada, China
Rapeseed or Canola Oil	4th	11.21	Canada, Germany, China (2021)
Safflower	5th	6.15	Kazakhstan, Russia, USA, Mexico
Safflower Seed Oil, Crude	2nd	18.43	USA (2021)
Sesame Seed	2nd	11.70	Sudan
Sesame Seed Oil	3rd	8.73	China, Myanmar (2021)
Linseed	5th	3.18	Russia, Kazakhstan, Canada, China
Linseed Oil	6th	5.03	China, Belgium, USA, Germany, Russia (2021)
Rice bran oil	1st	46.8	NA
Cotton seed oil	2nd	28.41	China
Coconuts, in shell	3rd	22.46	Indonesia, Philippines
Coconut oil	3rd	14.20	Indonesia, Philippines

***Source:** Author's computation from FAOSTAT database*

India's strength extends to other oilseeds and oils, too. The country ranks third globally in coconut production (shells and oil, behind Indonesia and Philippines) and sesame seed oil production (behind China and Myanmar), contributing 22.46%, 14.2%, and 8.73% of the global market share, respectively. In rapeseed production, India takes the third position (13.72% of the global share, behind Canada and China). In contrast, for rapeseed or canola oil production, it ranks fourth (11.2% share, behind Canada, Germany and China), highlighting its significant role in rapeseed-mustard cultivation. India is also the world's fifth largest producer of soybean and soybean oil (behind Brazil, USA, Argentina and China), contributing 3.72% and 2.14% of the global market share, respectively. While safflower cultivation positions India as the fifth largest producer globally (6.15% share), the country faces competition from other producers like Kazakhstan, Russia, USA and Mexico. Finally, India ranks fifth in linseed production (3.18% share, behind Russia, Kazakhstan, Canada and China) and sixth in linseed oil production (5.03% share), following established countries like China, Belgium, USA, Germany, and Russia, posing challenges in these segments.

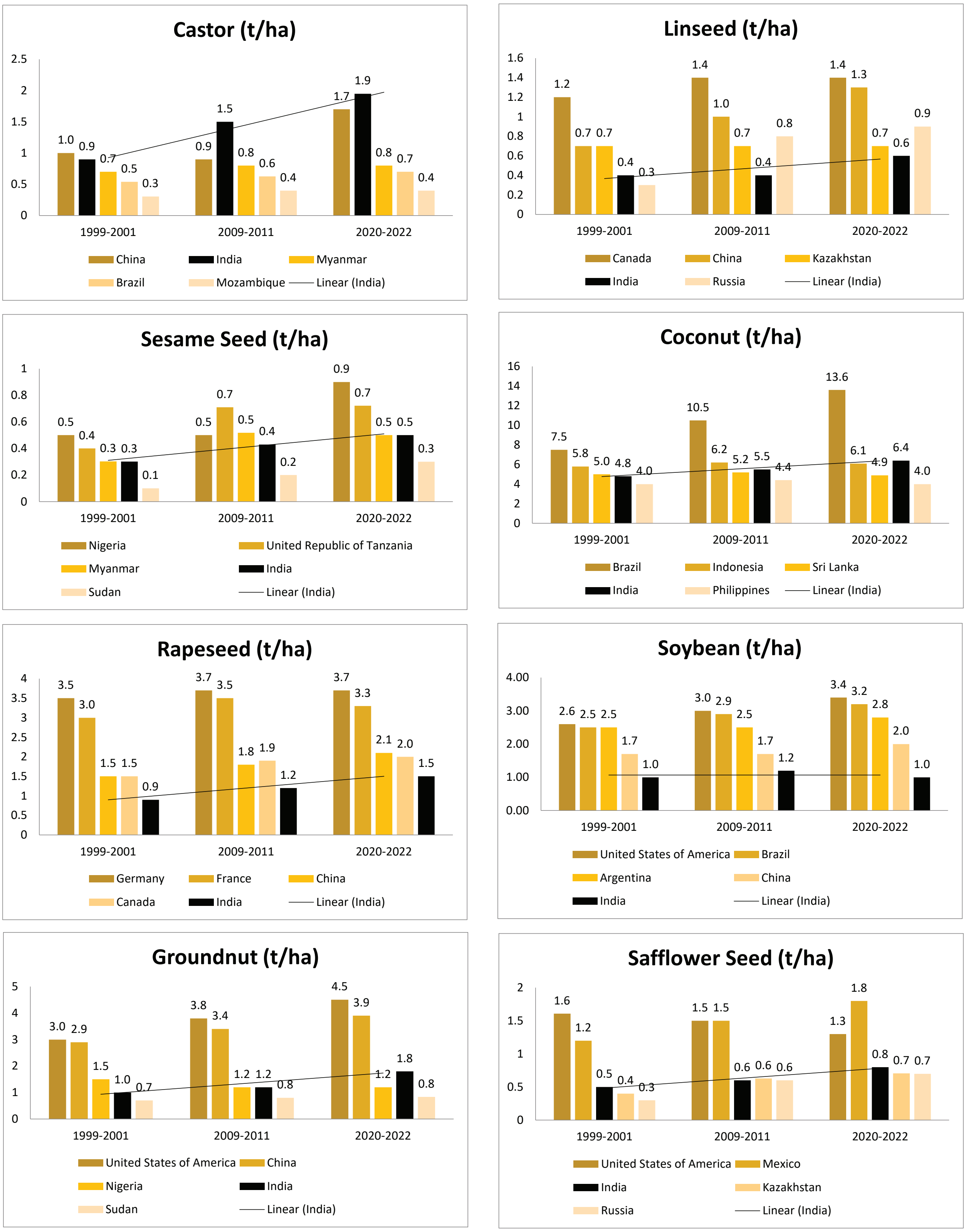
Despite its strengths in various oilseed sectors, a critical gap exists in India's palm and sunflower oil production. This negligible contribution to the global market for these oils hinders India's overall competitiveness on the international stage. India must prioritise strategies to boost domestic production of palm and sunflower oil to achieve greater self-sufficiency and enhance its position in the global edible oil market. This could involve investments in research and development of high-yielding, climate-resilient varieties, exploring suitable growing regions, and implementing farmer support programs to encourage wider adoption of these crops. By addressing this gap, India can strengthen its overall edible oil sector and reduce its dependence on volatile import markets.

2.6 Decadal Yield Comparison of Major Oilseed Producers

While India ranks among the largest global oilseed producers, a closer look reveals significant disparities in yield compared to other major producers (Figure 2.5). Figure 2.5 presents decadal yield comparisons (t/ha) between India and other major producers, utilizing a three-year average (1999-2001, 2009-2011, and 2020-2022) to ensure robust trend analysis. The data highlights a critical area for improvement in India's oilseed sector. Understanding and addressing these yield gaps will be paramount to enhancing domestic production and achieving greater self-sufficiency in the edible oil market.

India's performance has been mixed across various oilseeds. Groundnut production has seen a positive trajectory, with yield rising from 1.0 t/ha in 1999-2001 to 1.8 t/ha in 2020-2022, reflecting an impressive 80% growth rate. However, the US maintains the global lead with a yield of 1.8 t/ha and a 50% growth rate. Similarly, the US leads in soybean production with a 30.7% growth rate. India has shown promise in rapeseed production, achieving a 66.67 % yield increase (0.9 t/ha to 1.5 t/ha) over the past two decades, surpassing Germany's modest 5.7% growth. Castor seed presents a bright spot, with India's yield experiencing a remarkable 111.12% surge (0.9 t/ha to 1.9 t/ha) compared to the same period. In contrast, sesame seed production showcases a different picture. Nigeria boasts the highest yield globally, with an 80% growth rate, while India's yield has grown moderately from 0.3 t/ha to 0.5 t/ha. Safflower seed production exhibits opposing trends, with the US witnessing a negative growth rate of 18.75% compared to India's positive growth of 60%. Linseed production reveals a similar pattern. India's yield has increased from 0.4 t/ha to 0.6 t/ha, while Canada's yield has grown from 1.2 t/ha to 1.4 t/ha. Finally, Brazil stands out in coconut yield, achieving a remarkable 81.34% growth rate (7.5 t/ha to 13.6 t/ha). India's coconut yield has also grown, transitioning from 4.8 t/ha to 6.4 t/ha over the same period, but at a slower pace (33.34%).

India's production of edible oils from secondary sources presents a picture of uneven performance. While holding the distinction of being the second-largest producer of seed cotton (unginned) globally, India falls short in terms of yield, highlighting a productivity gap. Similarly, despite contributing a significant 25-30 % to global rice production, India's rice bran yield lags behind that of other major rice-producing nations. This indicates potential areas for improvement in harvesting and processing techniques to enhance rice bran oil production. Furthermore, India's palm oil production remains negligible on the global stage. These disparities allow India to leverage its existing strengths in secondary edible oil production from secondary sources and implement targeted strategies to close yield gaps.



***Source:** Author's computation from FAOSTAT database*

Figure 2.5: Yield comparison across highest producer countries (1999-2022 unit: t/ha)

CHAPTER-III

OVERVIEW OF INDIA'S EDIBLE OIL SECTOR

OVERVIEW OF INDIA'S EDIBLE OIL SECTOR

India has a diverse ecological landscape, enabling various edible oil crops to be cultivated. However, the area dedicated to oilseed production, the volume produced, and overall yield exhibit significant variations across the nation. A six-year average (2017-18 to 2022-23) of cultivation area, production, and productivity has been analysed to account for these variations and mitigate the impact of potential fluctuations. This analysis provides a more comprehensive understanding of India's oilseed sector and is a valuable baseline for future strategic planning and policy interventions.

Figure 3.1 presents an overview of India's area dedicated to cultivating nine major oilseed crops. Soybean reigns supreme, occupying the largest area at 11.74 Mha, followed by rapeseed and mustard at 7.08 Mha. Groundnut cultivation holds the third position with 5.12 Mha. Sesame (1.58 Mha) and castor seed (0.89 Mha) are other significant contributors. Sunflower, linseed, nigerseed, and safflower occupy considerably smaller areas, with safflower cultivation at a minimum of 0.07 Mha.

Soybean leads the pack with the highest output of 12.66 MT, closely followed by rapeseed and mustard at 10.27 MT. Groundnut production is substantial as well, at 9.43 MT. Castor seed and sesame hold moderate production levels of 1.57 MT and 0.75 MT, respectively. The remaining oilseeds – sunflower, linseed, safflower, and nigerseed - contribute significantly lower volumes, with nigerseed production at the lowest (0.04 MT). This data underscores the dominance of soybean, rapeseed, mustard, and groundnut in India's oilseed production landscape, while highlighting the need for potential strategies to enhance the cultivation and productivity of other oilseeds to achieve greater diversification and self-sufficiency. The detailed state-wise contribution of oilseeds is discussed in the next section.

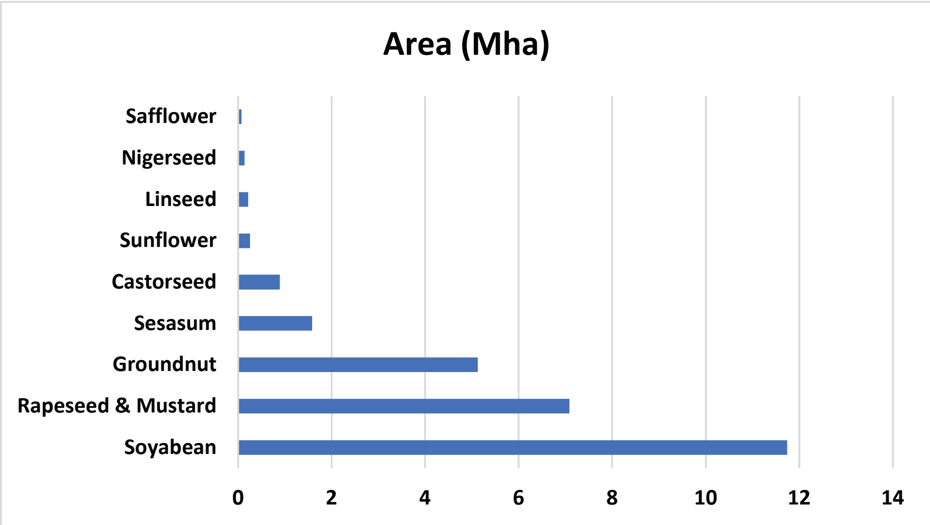
3.1 Oilseed Area, Production and Yield: State-Level Dynamics in India

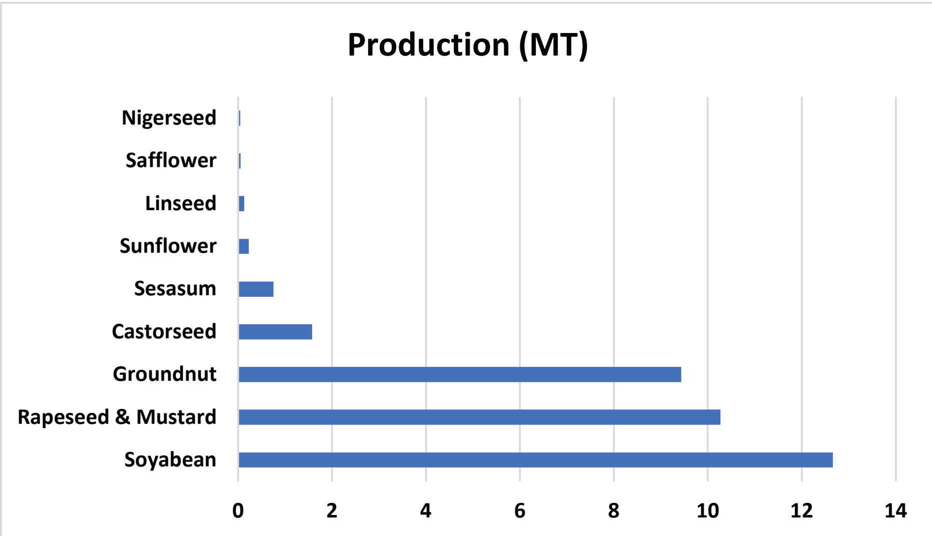
3.1.1 Oilseed Cultivation: Overall

Area: Madhya Pradesh has the highest area under cultivation, totalling 7.29 Mha, followed by Rajasthan (4.97 Mha), Maharashtra (4.58 Mha), Gujarat (2.97 Mha), and Uttar Pradesh with 1.20 Mha.

Production: Rajasthan and Madhya Pradesh have the highest production of around 21.42% each, of the national production, followed by Gujarat (17.24%), and Maharashtra (15.83%). Together, these four states contribute to 75.63% of the total production in the country.

Yield: The national average yield over the last six years (2017-2022) has stood at 1.27 t/ha. States such as Tamil Nadu, Gujarat, Haryana, Telangana, and Rajasthan, have surpassed this average, achieving yields of 2.49 t/ha, 1.97 t/ha, 1.94 t/ha, 1.81 t/ha, and 1.47 t/ha, respectively. Conversely, states like West Bengal (1.19 t/ha), Maharashtra (1.18 t/ha), Uttar Pradesh (1.03 t/ha), Madhya Pradesh (0.99 t/ha), and Karnataka (0.94 t/ha) have recorded yields lower than the national average. Map 3.1 showed the detailed information on the area, production, and productivity of total oilseeds across different states in India.





***Source:* DoA&FW**

Figure 3.1: Area and Production of oilseeds in India (2017-2022)

3.1.2 Oilseed Cultivation: Kharif Season

Area: In terms of Kharif cultivation area, Madhya Pradesh leads with 6.39 Mha, followed by Maharashtra (4.45 Mha), Gujarat (2.71 Mha), and Rajasthan (2.22 Mha). These four states account for 83% of the total Kharif national oilseed acreage.

Production: Madhya Pradesh has the highest production (i.e., 0.59 MT), constituting around 26.53% of the national production, followed by Gujarat (23.94%), Maharashtra (23.55%), and Rajasthan (12.78%). Together, these four states contribute to 86.82% of the total Kharif oilseed production in the country.

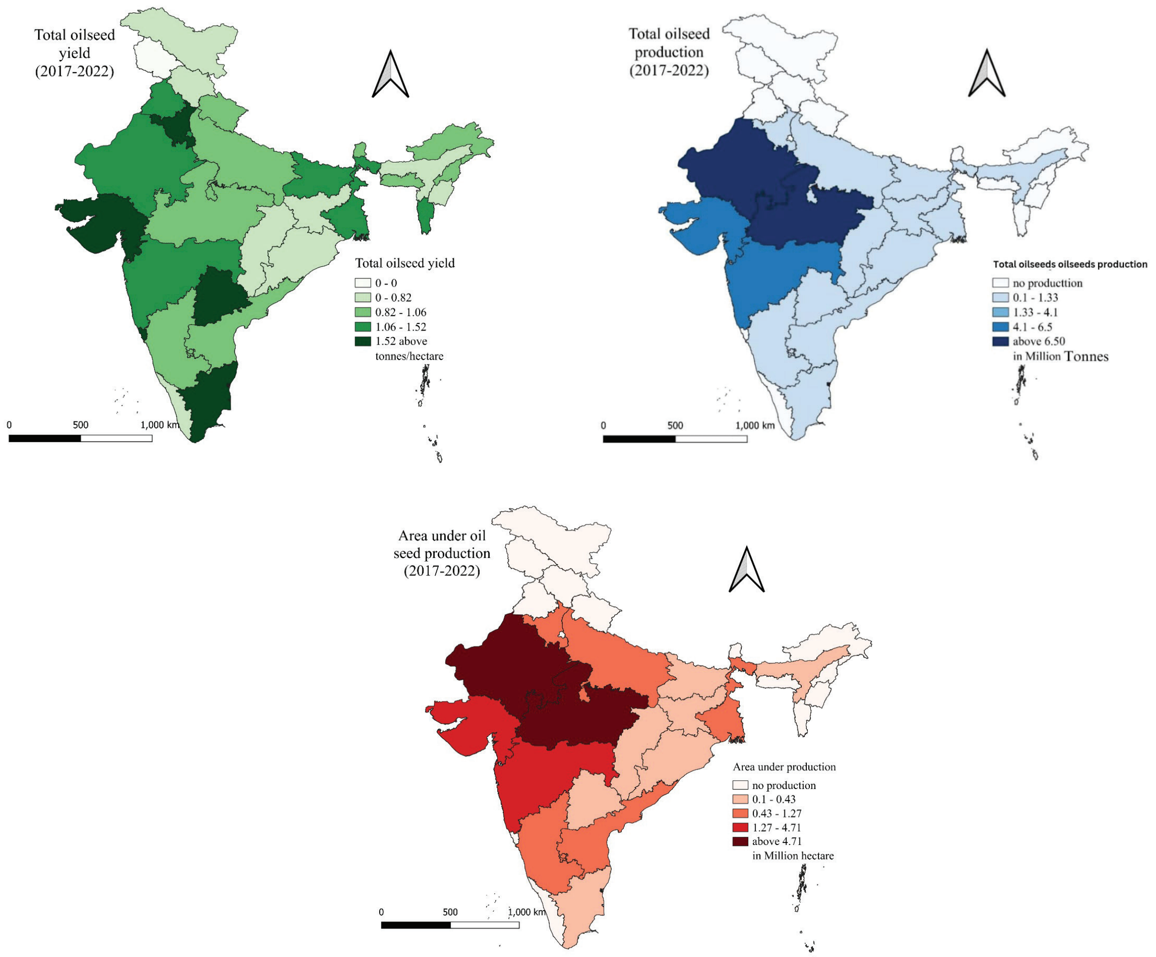
Yield: Among the major producers, states such as Gujarat (1.97 t/ha), Rajasthan (1.28 t/ha), Maharashtra (1.18 t/ha) have a higher yield than the national average (i.e., 1.17 t/ha). On the other hand, states such as Karnataka (0.93 kg/ha), Madhya Pradesh (0.92t/ha), Andhra Pradesh (0.75 t/ha) have lower yields than the national average. Map 3.2 illustrates the total area, production, and productivity of Kharif oilseeds across different states in India.

3.1.3 Oilseed Cultivation: Rabi Season

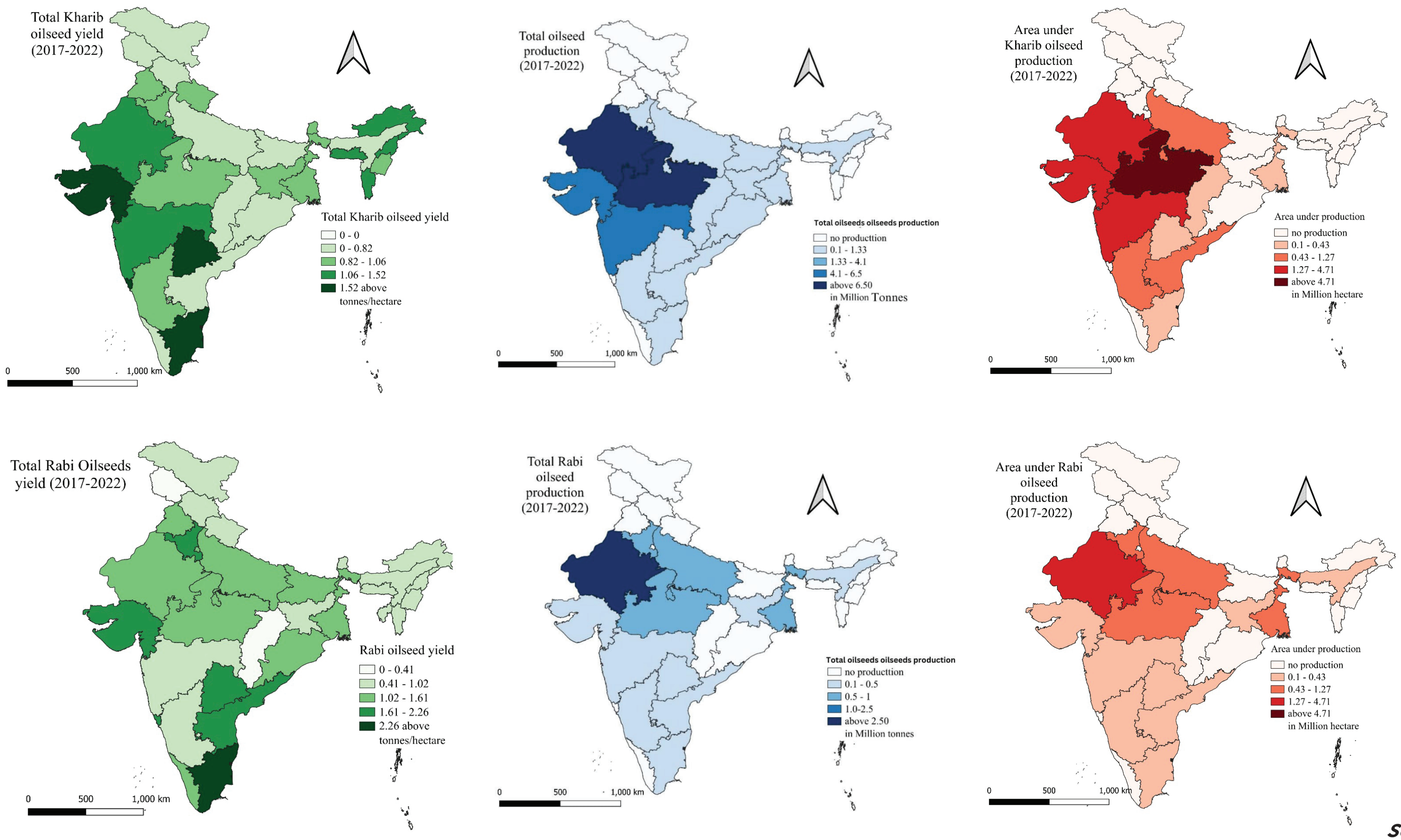
Area: In terms of Rabi cultivation area, Rajasthan leads with 2.76 Mha, followed by Madhya Pradesh (0.90 Mha), Uttar Pradesh (0.76 Mha), West Bengal (0.68 Mha) and Haryana with 0.64 Mha. These five states collectively account for 73% of the total area, with Rajasthan alone representing 35%, followed by Madhya Pradesh with 11.4%.

Production: Rajasthan has the highest production (i.e., 4.43 MT) of Rabi oilseeds at 37.91% of the national production, followed by Madhya Pradesh (1.26 MT), Haryana (1.25 MT), Uttar Pradesh (1.03 MT), and West Bengal (0.91 MT). Together, these five states contribute to 76.1% of the total Rabi production in the country.

Yield: States such as Tamil Nadu (3.54 t/ha), Haryana (1.95 t/ha), Gujarat (1.94 t/ha), Rajasthan (1.61 t/ha) have a higher yield than the national average (i.e., 1.48 t/ha). On the other hand, states such as Madhya Pradesh (1.41 t/ha), Uttar Pradesh (1.36 t/ha), West Bengal (1.32 t/ha) and Jharkhand (0.74 t/ha) have lower yields than the national average. The state-wise depiction of Rabi oilseeds is shown in Map 3.3.



Map 3.1: Total area, production and productivity under oilseed crops (2017-2022)



Source: DoA&FW

Map 3.2: Total area, production and productivity under Kharif and Rabi oilseeds crops (2017-2022)

Table 3.1 gives details of leading states contributing to India's edible oil crop acreage and production, a closer look reveals geographic variations in dominance for specific crops. Madhya Pradesh is the top contributor to total oilseed production, followed by Rajasthan and Gujarat. However, individual crop leadership varies. Rajasthan takes the lead in mustard cultivation, while Madhya Pradesh excels in soybean production. For sunflower and coconut, Karnataka and Kerala emerge as frontrunners, respectively. It is noteworthy that Uttar Pradesh and West Bengal hold significant areas for rice cultivation, whereas Maharashtra and Gujarat lead in cotton production.

Table 3.1 also indicates that cumulative production shares in oilseeds predominantly come from the top three or four states. For instance, Madhya Pradesh, Rajasthan, and Gujarat collectively contribute significantly to the total oilseed production, accounting for approximately 60% of the total production in some cases. This trend is observed across various oilseed crops, emphasizing the concentrated production contribution from these states. For example, in mustard cultivation, Rajasthan leads with a substantial production share, followed by Madhya Pradesh and Uttar Pradesh. A similar pattern is evident in soybean and sunflower cultivation, where Madhya Pradesh and Maharashtra play dominant roles. These concentrated production patterns necessitate policy interventions to encourage oilseed cultivation in other suitable regions, fostering a more geographically balanced and resilient oilseed sector for India.

Table 3.1: Top three states in Area and Production of edible oil crops (2017-2022)

Edible oil crops	States	Area contribution (%)	States	Production (MT)	Production contribution (%)	Cumulative share of production (%)
Total oilseeds	MP	26.88	Rajasthan	7.65	21.69	21.69
	Rajasthan	19.03	MP	7.37	20.92	42.61
	Gujarat	10.99	Gujarat	6.10	17.3	59.91
Groundnut	Gujarat	35.37	Gujarat	3.99	42.29	42.29
	Rajasthan	14.67	Rajasthan	1.64	17.35	59.64
	AP	14.42	Tamil Nadu	0.99	10.48	70.12
Mustard	Rajasthan	41.68	Rajasthan	4.66	45.36	45.36
	MP	12.03	MP	1.27	12.34	57.70
	UP	11.13	Haryana	1.11	12.16	69.86
Soybean	MP	49.07	MP	5.39	42.55	42.55
	Maharashtra	35.39	Maharashtra	5.27	41.62	84.17
	Rajasthan	8.89	Rajasthan	1.00	7.88	92.05
Sunflower	Karnataka	56.72	Karnataka	0.11	49.59	49.59
	Maharashtra	11.95	Odisha	0.02	8.89	58.48
	Odisha	6.19	Haryana	0.02	7.71	66.19

Edible oil crops	States	Area contribution (%)	States	Production (MT)	Production contribution (%)	Cumulative share of production (%)
Sesame	MP	20.97	West Bengal	0.22	28.64	28.64
	UP	20.56	MP	0.15	20.29	48.93
	Rajasthan	16.7	Gujarat	0.10	13.06	61.99
Safflower	Karnataka	49.36	Karnataka	0.03	55.45	55.45
	Maharashtra	39.33	Maharashtra	0.02	35.87	91.32
	Telangana	6.61	Telangana	0.00	8.05	99.37
Niger seed	Odisha	35.23	Odisha	0.02	41.47	41.47
	Chhattisgarh	30.68	Chhattisgarh	0.01	19.14	60.61
	MP	14.21	MP	0.01	14.96	75.57
Linseed	MP	33.89	MP	0.05	36.83	36.83
	Jharkhand	21.54	Jharkhand	0.03	20.01	56.84
	UP	14.27	UP	0.02	14.84	71.68
Castor	Gujarat	72.08	Gujarat	1.29	82.01	82.01
	Rajasthan	19.32	Rajasthan	0.24	14.95	96.96
	AP	3.43	AP	0.01	0.92	97.88
Rice	West Bengal	11.96	West Bengal	15.97	13.04	13.04
	UP	10.77	UP	12.79	10.44	23.48
	Odisha	8.73	Punjab	12.77	10.43	33.91
Coconut	Kerala	35.74	Kerala	6.86	32.94	32.94
	Karnataka	28.09	Tamil Nadu	5.40	25.91	58.85
	Tamil Nadu	20.49	Karnataka	5.17	24.8	83.65
Cotton	Maharashtra	33.86	Gujarat	8.10	23.36	23.36
	Gujarat	19.4	Maharashtra	7.67	23.38	46.74
	Telangana	15.65	Telangana	5.38	16.41	63.15

Source: *Author's computation*

3.2 Analysing Growth Trends and Instability in Edible Oil Crops Production

This section delves into the growth trends of major oilseed and secondary edible oil crops over the past four decades (1980-2022) by employing trend growth rates. Understanding the variability and growth patterns in agricultural production is crucial to assessing changes in output over time and formulating effective policy interventions for the edible oil sector. To achieve this objective, the Cuddy-Della Valle Instability (CDVI) index, which incorporates trend analysis into the traditional coefficient of variation, is utilized alongside decomposition analysis (Cuddy & Della Valle, 1978). This combined approach provides a more comprehensive understanding of the factors influencing production growth and instability, paving the way for well-informed policy options to enhance the stability and sustainability of India's edible oil sector.

3.2.1 Trend Growth Rate Analysis

The growth rate of area, production, and productivity of edible/non-edible oils in India has been calculated for five time periods viz. 1980-2022 (overall period), 1980-1990, 1991-2000, 2001-2010 and 2011-2022 (Table 3.2).

Table 3.2: Trend growth rate of area, production and productivity of edible/non-edible oils in India (1980- 2022)

Years (Period)		1980-2022	1980-1990	1991-2000	2001-2010	2011-2022
Edible Oilseeds						
Groundnut	Area	-1.27	1.64	-2.3	-0.96	-0.25
	Production	0.5	3.75	-1.25	0.77	2.76
	Yield	1.8	2.07	0.78	2.76	4.24
Rapeseed & Mustard	Area	1.08	1.94	0.72	3.34	0.12
	Production	3.16	7.29	0.77	5.7	2.94
	Yield	1.8	5.35	0.63	2.2	3.27
Soybean	Area	7.52	17.11	10.23	5.72	1.87
	Production	8.75	18.05	13.05	8.93	-0.55
	Yield	1.13	0.61	2.56	3.02	-2.39
Sunflower	Area	-0.79	26.25	-2.98	4.29	-9.07
	Production	0.2	22.07	-3.21	6.13	-11.93
	Yield	0.37	-3.57	-0.02	1.74	-8.69
Sesame	Area	0.99	-0.58	-5.5	1.6	-2.05
	Production	0.89	3.22	-4.8	1.42	-1.21
	Yield	1.91	3.72	0.72	-0.12	0.94
Safflower	Area	-6.4	2.3	-4.72	-3.88	-16.99
	Production	-5.77	1.8	-3.76	0.31	-16.21
	Yield	0.76	-0.48	0.83	4.58	1.58
Niger seed	Area	-3.16	1.06	-2.27	-1.7	-10.37
	Production	-2.86	2.67	-3.21	0.01	-9.46
	Yield	0.34	1.58	-0.81	1.39	0.49
Non-Edible Oilseeds						
Linseed	Area	-5.34	-4.89	-4.66	-4.12	-6.32
	Production	-3.45	-3.14	-2.53	-2.96	-2.56
	Yield	2.04	1.85	2.07	1.25	3.95
Castor	Area	1.48	1.57	-0.32	-0.57	-3.29
	Production	4.93	3.63	3.51	6.48	-1.71
	Yield	1.89	1.54	3.95	7.2	1.83
Total Oilseeds	Area	0.9	2.85	-0.88	2.2	0.57
	Production	2.84	5.99	0.56	5.36	2.12
	Yield	1.91	3.06	1.45	3.08	1.53
Secondary Sources						
Coconut (Coconut Oil)	Area	1.67	3.47	2.34	0.1	0.75
	Production	3.17	4.69	2.69	3.51	-0.26
	Yield	1.47	1.18	0.35	3.4	-1

Years (Period)		1980-2022	1980-1990	1991-2000	2001-2010	2011-2022
Edible Oilseeds						
Cotton (Cottonseed)	Area	0.71	-1.26	2.71	2.03	0.82
	Production	3.31	2.8	2.3	13.61	-0.55
	Yield	2.58	4.09	-0.42	11.34	-1.35
Rice (Rice Bran)	Area	0.52	0.42	0.67	-0.02	0.47
	Production	2.4	3.61	2.02	1.58	2.26
	Yield	1.87	3.19	1.34	1.6	1.78

Source: *Authors' computations using data from MoAF&W*

Note: Negative growth rate shown in pink, light green indicates growth exceeding 2%, and dark green indicates growth exceeding 5%.

From 1980 to 2022, the total oilseeds area grew at a modest rate of 0.90%, while production and yield increased more significantly at 2.84% and 1.91%, respectively. The 1980s saw robust growth, with area, production, and yield rising by 2.85%, 5.99%, and 3.06%. However, in the 1990s, the area declined by 0.88%, resulting in a low production growth of 0.56%, despite a 1.45% increase in yield. The early 2000s experienced a resurgence in area and yield growth, at 2.20% and 3.08%, boosting production by 5.36%. In the last decade (2011-2022), growth rates slowed, with area increasing by 0.57%, production by 2.12%, and yield by 1.53%.

During the last decade (2011-2022), among the nine oilseed crops, only soybean and rapeseed-mustard exhibited positive annual compound growth rates in the area, at 1.87% and 0.12%, respectively. In the same period, the CAGR revealed that the area under safflower decreased the most significantly (16.99%), followed by sunflower (9.07%), linseed (6.32%), and castor seed (3.29%). Rapeseed-mustard showed the highest growth rate in production (2.94%), followed by groundnut (2.76%). The decelerated growth rate in production was noticed in safflower declined the most (16.21%), followed by sunflower (11.93%), nigerseed (9.46%), linseed (2.56%), sesame (1.21%), and soybean (0.55%). The accelerated growth rate in productivity was noticed in 7 oilseed crops such as groundnut (4.24%) followed by linseed (3.95%), rapeseed-mustard (3.27%), castor seed (1.83%), safflower (1.58%), sesame (0.94%), and nigerseed (0.49%). However, a decelerated growth rate in productivity was observed in sunflower (8.69%) and soybean (2.39%) over the last decade.

Over the period from 1980 to 2022, the cultivation area for only four specific oilseed crops, soybean, sunflower, mustard, and castor, demonstrated an increase in cultivation areas. The most significant improvement was in soybean cultivation, a remarkable increase from 0.61 Mha in 1980 to 12.61 Mha in 2022.

Amongst the secondary oil crops, from 1980 to 2022, the coconut area grew steadily at 1.67%, with production increasing by 3.17% and yield by 1.47%. Cotton saw a modest area increase of 0.71%, with a significant production rise of 3.31% and yield growth of 2.58%. Rice experienced a slight area increase of 0.52%, with production growing by 2.40 % and yield by 1.87%. Over the decades, coconut production faced declines in the last decade, cotton production surged in the early 2000s, and rice maintained consistent growth in both production and yield throughout.

The detailed analysis of growth for each edible oil crop is discussed in the following section.

3.2.1.1 Groundnut

Groundnut acreage in the country has fluctuated over the years, and area has declined from 6.5 Mha to 4.7 Mha as farmers are shifting from Groundnut to other remunerative crops. Area has shrunk continuously while the yield has been increasing in the last 42 years (1980-2022) establishing an inverse relationship between the productivity and cultivated area. The increased productivity of groundnut is largely due to improvements in Rajasthan and Gujarat. Rajasthan, ranking second in production, exhibited an impressive 91% yield increase, from 1.1 t/ha to 2.1 t/ha. Meanwhile, Gujarat saw an 18.4% rise in productivity from 1.9 t/ha to 2.3 t/ha over the last decade. The productivity decline in Tamil Nadu is concerning, as it has decreased by 10.38% over the past decade. For the same decade, Rajasthan showed a remarkable 379% increase in production, while Gujarat demonstrated a 155% increase.

3.2.1.2 Rapeseed and Mustard

In the period (1980-2022), the CAGR in area, production, and productivity of total rapeseed and mustard in India recorded was 1.08, 3.16, and 1.8 %, respectively. Area of rapeseed and mustard showed maximum growth in the year 2001-2010 while minimum growth in the recent decade, i.e. 0.12. The last decadal growth rate in production and productivity was 2.94 % and 3.27%, respectively. Rajasthan, Madhya Pradesh, and Haryana collectively account for approximately 70% of the total crop production. These leading states have demonstrated growth in area, production, and productivity, with the exception of Haryana, where the yield has decreased by 10.3 % over the last decade, dropping from 1.9 t/ha to 1.7 t/ha.

3.2.1.3 Soybean

In recent decades, soybean cultivation in India has shown a favorable trend, marked by notable increases in both area and production. The cultivated area for soybean has increased from 6.42 Mha in 2000-01 to 12.91 Mha in 2021-22. Likewise, soybean production has seen a significant increase, increasing from 5.2 MT in 2000-01 to 12.6 MT in 2021-22.

A significant challenge facing the soybean sector is its low yield despite increasing trends in both area and production. The most notable decline in yield occurred during the last decade (2011-20), with a negative growth rate indicating a decrease of 2.3% annually. Madhya Pradesh, Maharashtra, and Rajasthan collectively account for 92% of total production. Among these dominant states, Madhya Pradesh experienced a slight decrease in area by approximately 1% and a decline in production by 15.2% over the last decade. During the same period, there was a drastic decrease in yield in Madhya Pradesh, from 2 t/ha to 0.9 t/ha, and in Maharashtra, from 1.3 t/ha to 1.02 t/ha in 2022. The declining trend in soybean yields in India is a cause for concern, as soybean is an important crop for the country, both for domestic consumption and for export.

3.2.1.4 Sesame

In the last 42 years (1980-2022), the area has shrunk continuously while the yield has been increasing in the same period establishing an inverse relationship between the productivity and cultivated area. In the last decade, the area of sesame was reduced from 1.9 M ha to 1.72 M ha, and production has gone down by -1.21 %. A major production decline was witnessed in Rajasthan in the last decade, decreasing from 0.22 Mha to 0.079 Mha (a decline of approximately 64%). Uttar Pradesh and Madhya Pradesh have seen stable cultivation areas over the past decade, while West Bengal has experienced a notable 43% increase in area, expanding from 0.18 Mha to 0.25 Mha.

In terms of production, Gujarat and Madhya Pradesh experienced minimal increases over the decade. However, West Bengal's production grew significantly from 0.16 MT to 0.25 MT (approximately 56.25%).

3.2.1.5 Sunflower

The overall growth of sunflower cultivation in India from 1980 to 2022 indicates a mixed performance across different states. Karnataka, Odisha, and Haryana contribute to 66% of the production, with Maharashtra also having a prominent area under sunflower cultivation. The area under sunflower cultivation experienced a negative growth rate of -0.79% (1980-2022), implying a slight decline in the cultivated area over the given period. Over the last decade, there has been a decline in area, primarily attributable to Maharashtra (from 0.208 M ha to 0.030 M ha in 2022-23, a decline of approximately 85.58%) and Odisha (from 0.020 M ha to 0.018 M ha, a decline of approximately 10%). However, the production of sunflower showed a positive growth rate of 0.2% over the period from 1980-2022, but in the last decade, it experienced a decelerating growth of 11.9%. Maharashtra is largely responsible for this decline, with total production dropping from 0.125 MT to 0.015 MT (an approximate decline of 88%).

3.2.1.6 Safflower

In the last 42 years both area and production has shrunk continuously while the yield has been increasing in the same period. Safflower have the least growth rates in terms of production and productivity. The area showed the positive growth trend only for decadal period 1980-90, but it has declined tremendously in the last decade with growth rate of -16.99 %. The area under safflower cultivation has slumped by 64% since 1991, while the production has witnessed a fall by 42% during the same period. Maharashtra, Karnataka, and Telangana contributed 99% of the overall safflower production in the country. In the last decade, both Maharashtra and Telangana showed declines in safflower acreage, by approximately 440% and 33%, respectively. Similarly, safflower production has declined tremendously in Maharashtra, dropping from 0.094 MT to 0.023 lakh tonnes in the last decade. In contrast, Karnataka showed a positive change in production, increasing from 0.046 MT to 0.056 MT, while Telangana's production has remained more or less the same over the last decade. The productivity in Telangana showed remarkable improvement, with a positive growth rate over the last decade, increasing from 0.67 t/ha to 0.90 t/ha (an increase of approximately 34.33%). Similarly, Maharashtra productivity increased from 0.5 t/ha to 0.7 t/ha (an increase of approximately 40 %) along with Karnataka.

3.2.1.7 Niger seed

Over the past 42 years, Niger seed cultivation in India has seen a decline in cultivated area and production, with growth rates of 3.16% and 2.86%, respectively. However, there has been a slight improvement in productivity, with a growth rate of 0.34%. From 2011 to 2022, Niger seed cultivation in India faced significant challenges, with Odisha, Chhattisgarh, and Madhya Pradesh-accounting for 75% of production-experiencing major declines in cultivated area. The overall area decreased by 10.37%, with notable reductions in Chhattisgarh (0.066 to 0.025 Mha), Madhya Pradesh (0.106 to 0.010 Mha), and Odisha (0.093 to 0.035 Mha). From 2011 to 2022, Niger seed production witnessed declines in key states such as Chhattisgarh experienced a 54.55% decrease, Madhya Pradesh saw an 86.96% decrease, and Odisha recorded a 65.79% decrease in production.

3.2.1.8 Secondary edible oils

In the last decade (2011-2022), the area under cotton and coconut cultivation increased modestly by 0.82% and 0.75 %, but production declined by 0.55% and 0.26%. The yield of cotton and coconut both also decreased by 1.35% and 1%, indicating challenges in maintaining productivity despite expanded cultivation. Rice production exhibited a positive trend over the entire period, with a 2.26% increase in the last decade. The area under rice cultivation saw a slight rise of 0.47%, and the yield improved by 1.78%, reflecting steady advancements in agricultural practices and production technologies. Overall, these trends illustrate the varied growth rates and productivity changes in secondary oils, with rice, as a staple crop, showing consistently positive growth rates in almost all decades.

3.3 Instability Analysis of Edible Oils

The agricultural sector is heavily dependent on climatic factors, making it highly susceptible to uncertainty. While growth with stability is considered ideal, growth often comes with instability. Growth rates alone typically do not capture the fluctuations or instability present in time series data. This is where measures like the Cuddy Della Valle Index become crucial, as they help quantify and categorize the instability, providing a clearer picture of the underlying variability in agricultural performance.

The Cuddy–Della Valle instability method (Cuddy and Della Valle, 1978) is used to measure instability in time series data for the total area, production, and yield of edible oils. Unlike the commonly used Coefficient of Variation (CV), which tends to overestimate instability in the presence of linear or non-linear trends, the Cuddy Della Valle method corrects this by adjusting the CV when data are scattered around trend lines. This prevents overestimation of the instability index. The study categorizes CDVI values into three levels: values below 15 indicate low instability, values between 15 and 30 signify medium instability and values above 30 represent high instability.

Table 3.3 presents the instability index of various edible crops. The results align with the findings of Chand and Raju (2009), suggesting that when a longer period is considered, reflecting the widespread adoption of improved technology across large areas, the notion of increased instability due to new technology adoption is refuted. Over extended periods, technological advancements in agriculture have contributed to stabilizing production and productivity, as evidenced by the generally moderate to low instability indices observed across various oilseed crops. This indicates that Indian agriculture has developed resilience to absorb various shocks in supply caused by climatic and other factors.

From 1980 to 2022, sunflower and safflower showed significant production instability, while castor exhibited variability in productivity. In the last decade (2011-2022), sunflower and safflower also experienced fluctuating acreage, highlighting challenges in maintaining consistent cultivation patterns for these crops. Among the major oilseed crops, mustard productivity exhibited high instability from the period 1981-2010. However, in the last decade (2011-2022), mustard productivity has shown signs of stability, marking a shift towards more consistent output in recent years.

Groundnut was highly stable in area and production during 1991-2000. However, in the last decade (2011-2022), there has been increased instability. Nigerseed and linseed have consistently shown stable figures in both area and production over the decades, indicating reliable cultivation patterns.

Among secondary oil crops like coconut, rice (rice bran), and cotton (cottonseed), area, production, and productivity have shown consistent stability in output and efficiency, highlighting their reliability in agricultural production.

Table 3.3: Instability in area, production and yield of edible oil crops in different periods between 1980-81 and 2022-23 at all India levels (%)

Edible oil Crops 1981-2022		Years (period)				
		1981-2022	1981-1990	1991-2000	2001-2010	2011-2022
Groundnut	Area	10.07	7.42	7.01	6.23	18.06
	Production	20.38	19.38	13.3	25.67	21.09
	Yield	18.75	13.34	13.01	20.3	16.75
Mustard	Area	14.12	9.12	5.57	15.63	13.46
	Production	17.64	12.75	10.76	18.77	11.9
	Yield	9.87	39.58	67.7	39.17	18.21
Soybean	Area	7.52	17.11	10.23	5.72	1.87
	Production	26.64	18.09	10.09	12.14	13.74
	Yield	21.84	12.5	7.18	4.68	6.02
Sunflower	Area	26.68	28.9	17.59	22.62	38.48
	Production	58.9	27.6	17.97	21.98	13.7
	Yield	27.04	15.17	7.35	12.68	33.76
Sesame	Area	7.12	7.15	5.95	6.28	6.32
	Production	15.8	14.01	10.35	16.26	8.92
	Yield	11.19	8.37	10.78	15.68	6.29
Safflower	Area	24.49	9.36	18.23	4.92	45.67
	Production	30.01	14.95	36.56	17.58	25.22
	Yield	19.72	16.1	28.09	13.83	16.9
Niger seed	Area	16.62	6.35	3.8	5.28	9.57
	Production	20.19	14.23	9.2	12.57	13.76
	Yield	9.9	9.7	7.42	7.57	6.52
Non-Edible Oilseeds						
Linseed	Area	10.36	6.96	7.67	7.03	14.91
	Production	12.46	9.42	8.93	4.24	17.23
	Yield	8.57	7.03	6.88	6.93	6.27
Castor	Area	18.28	22.17	8.12	18.49	15.82
	Production	26.74	33.14	10.82	19.72	17.77
	Yield	37.76	22.29	10.69	9.53	4.99
Secondary Sources						
Coconut (Coconut Oil)	Area	7.45	2.78	4.91	1.97	3.04
	Production	12.93	8.85	7.52	5.89	9.76
	Yield	11.21	6.53	5.79	6.76	8.67
Cotton (Cottonseed)	Area	13.32	5.52	5.42	6.91	5.8
	Production	25.55	17.84	10.25	14.42	7.62
	Yield	16.69	13.02	8.72	14.44	7.6
Rice (Rice Bran)	Area	4.37	0.03	1.35	3.55	1.7
	Production	8.72	8.32	3.12	8	3.05
	Yield	6.77	5.68	2.59	5.32	2.39

***Source**: Authors' computations using data from MoAF&W*

The production of palm in India has not been continuous over the decades, making it challenging to collect decade-wise data. Therefore, the area, production, and status of palm cultivation are discussed separately due to the discontinuous nature of data availability.

3.4 Palm cultivation in India

Palm oil production in India has come a long way since its introduction in the 1970s. The significant growth phase started in the 1990s and picked up pace in the 2000s, supported by government schemes and missions. In August 2021, the government launched the National Edible Oil Mission-Oil Palm (NMEO-OP) to further boost domestic production and reduce import dependency.

Area: The national area under oil palm cultivation in India surged from 44,788 ha to 3,70,028 ha during 2004-05 to 2020-21. Andhra Pradesh led this growth, increasing from 27,514 ha to 184,640 ha, representing 52.1% of the total share. Significant expansions were also seen in Karnataka (from 2,124 ha to 46,954 ha, 13.2%), Tamil Nadu (from 5,913 ha to 32,982 ha, 9.3%), Mizoram (26,680 ha, 7.5%), Odisha (from 1,484 ha to 23,130 ha, 6.5%), and Telangana (21,382 ha, 6.0%).

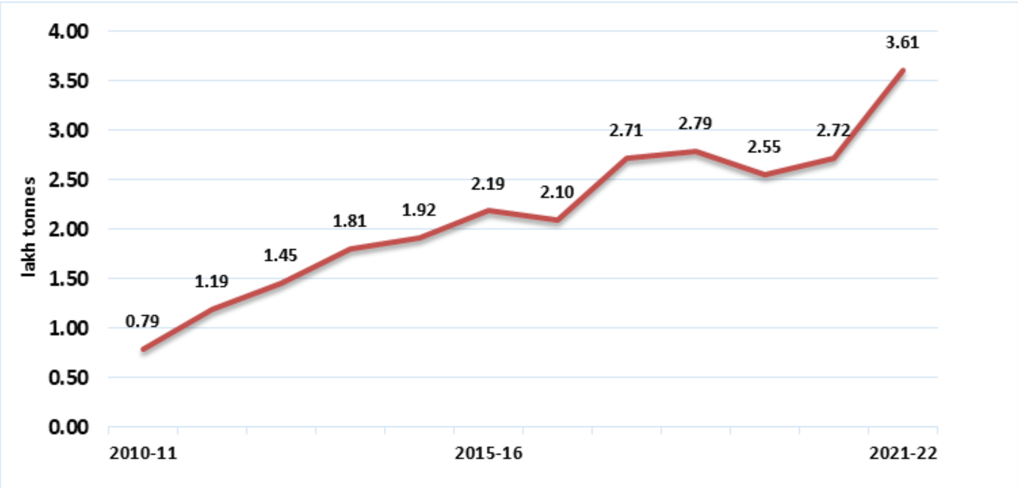
Table 3.4: State-wise cultivated area under oil palm cultivation in India

State	Area (ha)	
	2004-05	2021-22
India	44,788	3,70,028
Andhra Pradesh	27,514	1,84,640
Karnataka	2,124	46,954
Tamil Nadu	5,913	32,982
Mizoram	NA	26,680
Odisha	1,484	23,130
Telangana	NA	21,382

Source: *Ministry of Agriculture and Farmers' Welfare*

The role of the North-Eastern Region (NER) is pivotal in achieving Atmanirbharta in edible oil, as the scope for Oil Palm production spans across six NER states: Arunachal Pradesh, Assam, Manipur, Mizoram, Nagaland, and Tripura, encompassing a vast potential area of 8.4 lakh hectares, which is 38% of the national potential (PIB, 2024).

Production: In the FY 2021-22, palm oil production in India exhibited varying levels across different states. The total palm oil production in India for the year reached 3.61 lakh tonnes.



Source: *Ministry of Agriculture and Farmers' Welfare*

Figure 3.2: Crude Palm oil production (2010-11 to 2021-22: lakh tonnes)

Table 3.5 presents state-wise production of crude palm oil (CPO) in India for the years 2008-2009 and 2021-2022. Andhra Pradesh leads with a significant increase from 43,593 tonnes in 2008-2009 to 295,075 tonnes in 2021-2022, reflecting a 14.33% growth rate. Telangana shows even more substantial growth, rising from 4,770 tonnes to 48,141 tonnes over the same period, with a growth rate of 20.59%. Karnataka's production expanded from 1,170 tonnes to 10,068 tonnes, marking a 10.43% growth rate. Mizoram recorded 6,775 tonnes in 2021-2022. Overall, India's CPO production grew from 58,167 tonnes to 360,729 tonnes, indicating a significant national increase in crude palm oil cultivation.

Table 3.5: State-wise production of Crude palm oil production

State	Crude palm oil production (in tonnes)	
	2008-2009	2021-2022
Andhra Pradesh	43,593	2,95,075
Telangana	4,770	48,141
Karnataka	1,170	10,068
Mizoram	NA	6,775
India	58,167	3,60,729

Source: *Ministry of Agriculture and Farmers Welfare (India)*

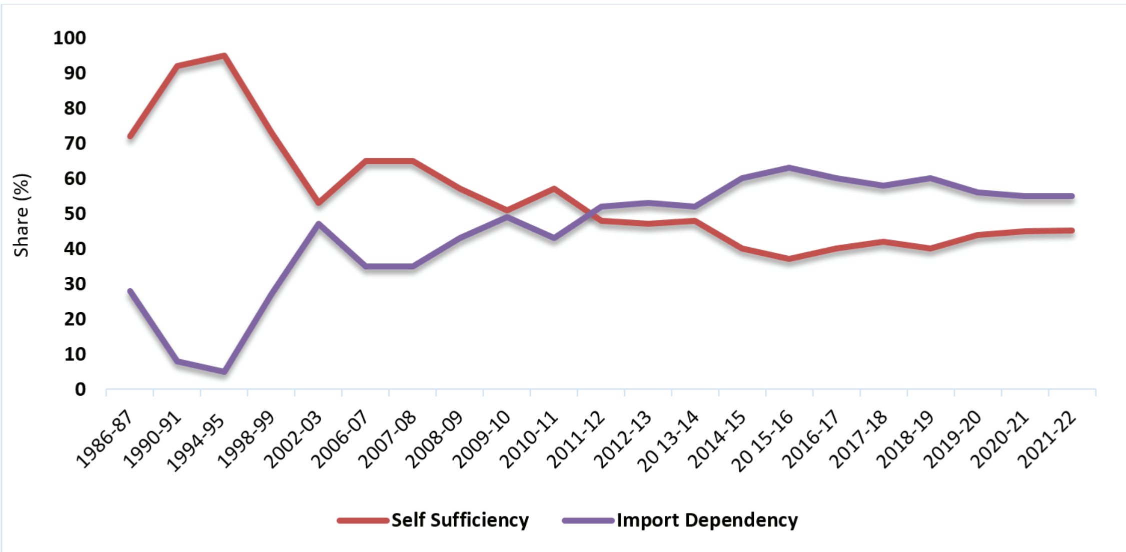
Yield: According to the Indian Institute of Oil Palm Research (IIOPR), oil palm is renowned for its high vegetable oil yield, yielding up to 5 t/ha. During the initial yield stabilization period, typically spanning 4 to 8 years after planting, the yield of fresh fruit bunches can attain around 12 t/ha. After this period, as the oil palm trees mature further, exceeding 8 years of growth, the yield can rise to approximately 20 t/ha. These figures highlight the progressive increase in productivity as oil palm trees mature and stabilize in their growth and fruit production.

3.5 Edible Oils Trade Dynamics: Import and Export

Edible vegetable oils stand out among agricultural commodities due to their exceptionally high trade volume. A staggering 41% of global production is traded internationally, driven in large part by major palm oil producers like Indonesia and Malaysia. These giants export over 70% of their own production, jointly accounting for nearly 60% of global palm oil exports (OECD-FAO, 2021). India, the world's largest importer, exemplifies this trend. Domestic demand for edible oils has grown steadily at a rate of more than 7% in the last decade, and the country currently relies on imports to meet 57% of its consumption needs. Palm oil dominates these imports, accounting for 59%.

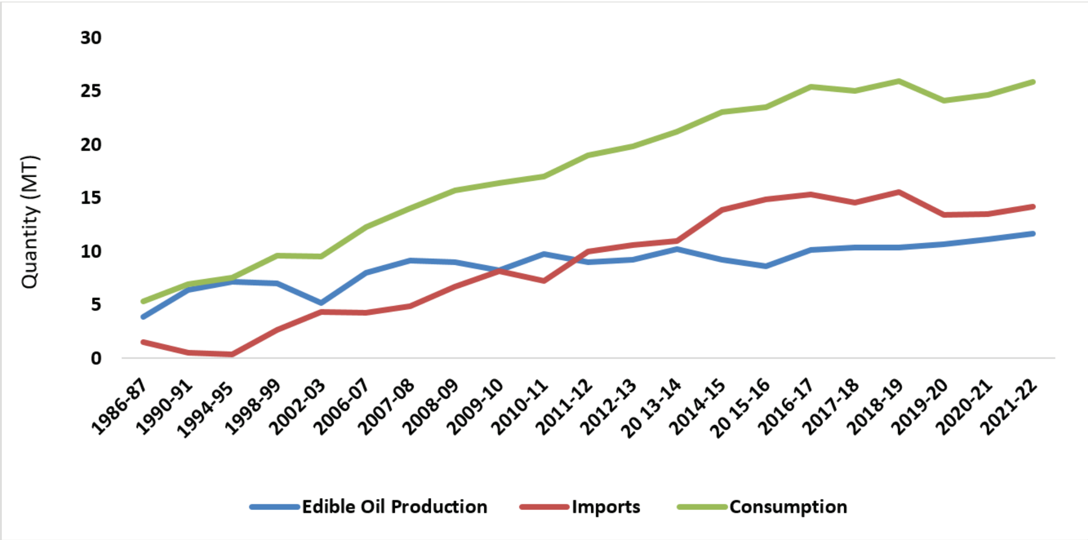
The Government of India has taken proactive steps to address import dependence and enhance domestic edible oil production. The Centrally Sponsored Scheme, National Food Security Mission- Oilseeds & Oil Palm (NFSM-OS&OP), launched in 2018-19, focuses on increasing the production and productivity of nine oilseed crops alongside area expansion for oil palm and tree-borne oilseeds (TBOs). This initiative was further bolstered in 2021-22 with the introduction of the National Mission on Edible Oil (NMEO)Oil Palm (NMEO-OP). This dedicated mission prioritizes oil palm cultivation, particularly in the North Eastern States and Andaman & Nicobar Islands, aiming to increase the area under oil palm cultivation from 0.37 Mha to 1 Mha by 2025-26 towards the increase in Crude Palm Oil (CPO) production in the country. Additionally, the Rashtriya Krishi Vikas Yojana-RAFTAAR (RKV-RAFTAAR) program provides support for crop production activities related to oilseeds. Building on these efforts, the 2024 budget announcement outlined a comprehensive strategy for achieving "Atmanirbharta" (self-sufficiency) in key oilseeds like mustard, groundnut, sesame, soybean, and sunflower. This strategy encompasses research for high-yielding varieties, widespread adoption of modern farming techniques, market linkages, procurement mechanisms, value-addition initiatives, and crop insurance schemes.

India's edible oil trade dynamics have significantly transformed over the past few decades. By the early 1990s, the country achieved near self-sufficiency, even emerging as a notable exporter of oilseed meal. However, the mid-1990s witnessed a surge in demand for edible oils, driven by a combination of factors: cheaper imports due to globalization and rapid economic growth leading to an increase in per capita consumption. This resulted in a growing reliance on imports to meet domestic needs. While the self-sufficiency percentage has fluctuated over the years, concerted government efforts have shown some success. Import dependence on edible oils has been brought down from a high of 63.2% in 2015-16 to 54.9% in 2021-22 (Figure 3.3). This translates to increased self-sufficiency from 36.8% to 45.1% during that period. However, this progress is overshadowed by the stark rise in overall consumption, which has exploded from 5.34 MT in 1986-87 to a staggering 25.84 MT in 2021-22. Domestic production, although increasing from 3.87 MT to 11.65 MT over the same period, has not kept pace with demand. This ever-widening gap is currently plugged by significant imports, which have grown from a mere 1.47 MT in 1986-87 to a concerning 14.19 MT in 2021-22 (Figure 3.4). The concerning trend continued in 2022-23, with imports further surging to an estimated 16.5 MT as total demand reached 28.9 MT based on preliminary data (1st advance estimates by DAC&FW), pushing the import dependency ratio back up to 57.07%.



Source: *Directorate of Vanaspati, Veg Oils and Fats*

Figure 3.3: Share of imports & self-sufficiency over the years (1986- 2022 unit: %)

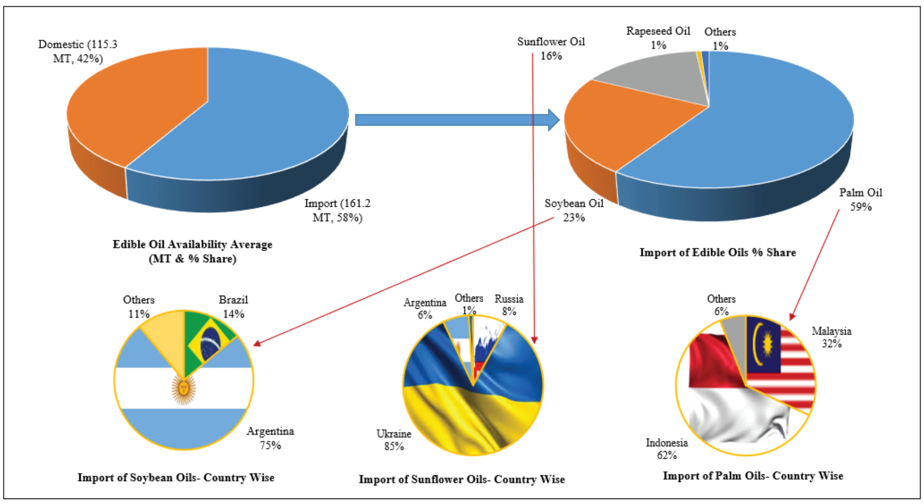


Source: Directorate of Vanaspati, Veg Oils and Fats

Figure 3.4: Production, Consumption & Imports of Edible oils in India

3.5.1 Imports

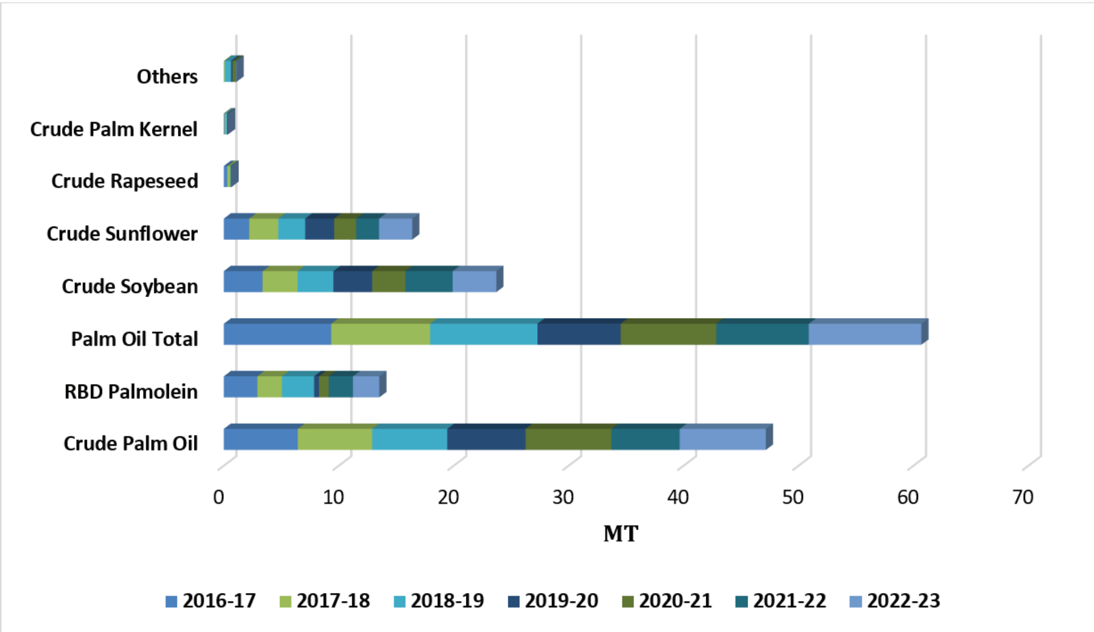
Edible oils emerged as a significant component of India's import basket. In the financial year 2022-23, ranked seventh among the most imported commodities. This category accounted for a noteworthy 3.1% share of the nation's total imports. Over the period 2016-17 to 2022-23, India's average import dependency for edible oils stood at 57%. Palm oil dominates these imports, accounting for 59% on average, followed by soybean oil (23%) and sunflower oil (16%). These three oils collectively constitute a staggering 98% of India's total edible oil imports (Figure 3.5). Furthermore, India exhibits a high degree of concentration in its import sources. For palm oil, Indonesia (62%) and Malaysia (32%) are the dominant suppliers. Soybean oil imports are heavily reliant on Argentina (75%) and Brazil (14%), while sunflower oil imports are sourced primarily from Ukraine (85%), followed by Russia (8%) and Argentina (6%). This reliance on a limited number of source countries underscores potential vulnerabilities associated with geopolitical instability, weather disruptions, and price fluctuations in those regions. The economic significance is further highlighted by the fact that total edible oil imports were valued at nearly ₹1400 billion, with palm oil accounting for a substantial 55%, followed by soybean oil (30%) and sunflower oil (15%).



Source: DFPD, DAC&FW, and Department of Commerce, Government of India

Figure 3.5: Edible Oil Availability and Import Share over 2016-17 to 2022-23

India's edible oil imports are primarily categorized into crude and refined oils. Crude oils, traditionally favoured for retaining more natural properties, have consistently formed a significant portion of these imports. During this period, palm oil consistently emerged as the dominant crude oil import (i.e., 45.8%) followed by crude soybean (23%), and crude sunflower (15.9%). A detailed breakdown of the specific types of edible oils imported by India from 2016-17 to 2022-23 is provided in Figure 3.6. Further, according to the Solvent Extractors' Association (SEA Handbook, 2023), India's refined edible oil imports reveal a significant surge in the contribution of RBD (Refined, Bleached, and Deodorized) Palmolein. It has swiftly escalated to 14% of total edible oil imports, marking a substantial increase from its share of 6% in 2020-21 and a mere 3% in 2019-20. It's worth noting that RBD Palmolein's share in total refined oil imports has consistently been 100% since 2007-08. Understanding this import profile is crucial for informing strategic decisions aimed at diversifying import sources, enhancing domestic production, and mitigating potential risks associated with import dependence.



Source: *DFPD, DAC&FW and Department of Commerce, Government of India*

Figure 3.6: Major Edible Oil Imported by India (2016-17 to 2022-23)

3.5.1.1 Bridging the Gap: Government Strategies to Balance Import Dependence and Domestic Production

India faces a complex challenge in its edible oil sector. The country grapples with the need to bridge the gap between its high import dependence and the need to incentivize domestic oilseed production. The Government of India has implemented a multifaceted strategy to address this issue, employing a dynamic import policy alongside farmers-centric Minimum Support Prices (MSPs) for oilseeds.

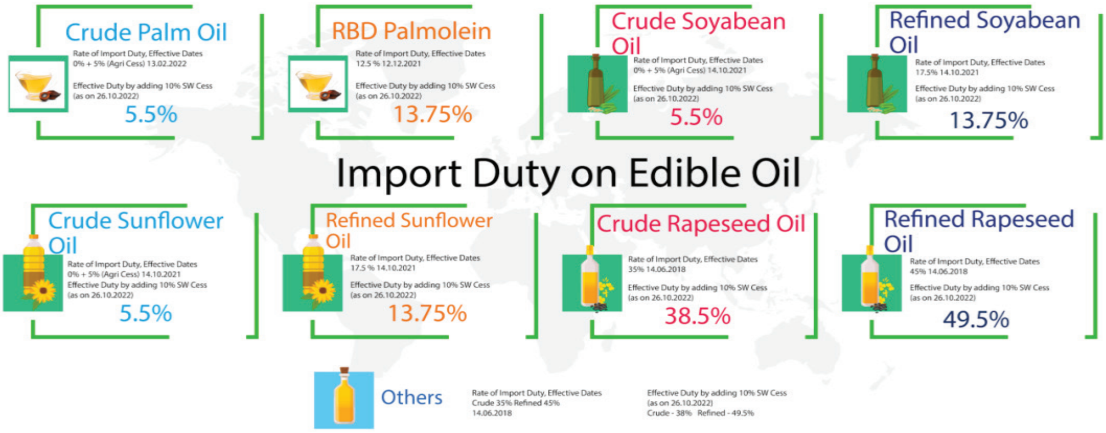
- **Understanding the Import Reliance:** Data from the Socio-Economic Assessment (SEA) sheds light on a key driver of import dependence - reduced import duties. Crude palm oil, soybean oil, and sunflower oil face a minimal duty of just 5.5%. This policy shift coincides with a significant rise in import reliance observed after 2011-12.

- **Lessons from the Past:** India's history offers valuable insights. The "Yellow Revolution," spearheaded by the Technology Mission on Oilseeds (TMO) during the 1990s, helped to achieve self-sufficiency in edible oils. This can be largely accrued to the government's price support and import substitution policies. However, due to various WTO agreements, the price support through customs and import taxes was reduced to extremely low, if not completely withdrawn.

- **The Challenge and the Response:** This shift in trade policies, coupled with a rising demand for edible oils, has created a widening gap between domestic production and import reliance. The Government of India's multifaceted strategy acknowledges this challenge.

- **Dynamic Import Management:** Open General Licenses (OGLs) are a crucial facilitator, enabling essential imports to bridge the demand-supply gap for edible oils. Import duty structures are strategically reviewed to balance the interests of various stakeholders. Temporarily, measures were introduced to stabilize cooking oil prices for consumers directly to control the rise in cooking oil prices. These measures included reducing basic import duties on crude palm, soybean, and sunflower oil to zero while significantly lowering the agri-cess from 20% to 5% (Figure 3.7). This policy, extended until March 31st, 2025, exemplifies the government's commitment to immediate price stabilization. Additionally, the basic import duty on refined palm oils was reduced from 17.5% to 12.5% in December 2021, and the same was true for refined sunflower and soybean oil, which was reduced from 17.5% to 12.5% in June 2023. This revised structure, extended until March 31, 2025, demonstrates the government's ongoing efforts to manage import costs for refined oils. Most significantly, the government extended the free import policy for refined palm oils until further notice, highlighting the government's commitment to ensuring continued availability for domestic consumption. This combination of import duty adjustments, temporary exemptions, and extended free imports highlights the multifaceted nature of India's dynamic import policy.

- **Incentivizing Domestic Production:** Further encouraging domestic production, the government annually announces MSPs for 22 mandated agricultural crops, including seven key oilseeds - groundnut, sunflower seed, soybean, sesame, nigerseed, rapeseed & mustard, and safflower. The increase in MSP for marketing season 2024-25 is in line with the Union Budget 2018-19 announcement of fixing the MSP at a level of at least 1.5 times the All-India weighted average cost of production. Over the period (2014-2024), the MSP for oilseeds has seen a significant increase, with nigerseed showing the highest relative change of 142.1%. Notably, the sesamum MSP has more than doubled with a 101.5% rise, while sunflower seed and soybean have also seen substantial growth at 94.1% and 91.1%, respectively (Annexure-I). This producer-centric approach provides financial security for farmers, incentivizing increased oilseed cultivation.



Source: Department of Food and Public Distribution, Ministry of Consumer Affairs

Figure 3.7: Import duty on edible oils

By acknowledging the historical context, employing a dynamic import policy focusing on immediate price stabilization and long-term import reduction strategies, and offering producer-centric MSPs, the Government is actively working towards achieving a sustainable balance between import dependence, domestic production encouragement and consumer welfare. A nuanced approach considering both cultivation economics and import dependence is crucial for success. Policy interventions should encourage the cultivation of high-return edible oil crops. These crops offer a strategic advantage due to their favourable return-on-cost ratios. Additionally, exploring measures to reduce the production cost of edible oils can further enhance profitability and incentivize farmers. By prioritizing high-return crops, implementing strategic import management, and promoting promising domestic alternatives like palm oil, India can significantly reduce import reliance and establish a more self-sufficient edible oil sector. This strategy fosters a win-win situation for producers, consumers, and the nation's food security.

3.5.2 Exports

Groundnut has emerged as the dominant export crop, accounting for around 60% of the total oilseed export share in 2021-22. Sesame seeds hold the second-largest export position, followed by soybean and rapeseed (Table 3.6).

Table 3.6: Total Export of Oilseeds (2019-20 to 2021-22)

Items	2019-20		2020-21		2021-22	
	Quantity	Value	Quantity	Value	Quantity	Value
Sesame seed	282.3	37.2	273.3	31.6	242.2	30.4
Groundnut	664.4	51.0	638.3	53.8	514.2	47.0
Rapeseed & Mustard	31.8	1.4	55.1	2.8	39.2	2.8
Niger seed	11.6	1.1	19.6	1.6	6.0	0.6
Safflower seed	2.6	0.1	4.0	0.2	2.9	0.2
Sunflower seed	1.2	0.1	1.3	0.1	1.5	0.1
Soybean	74.7	3.1	68.5	3.1	43.4	3.1
Linseed	12.0	0.8	11.9	0.9	11.2	1.2
Cottonseed	0.4	0.2	0.7	0.2	0.2	0.2
Total	1080.9	95.0	1072.8	94.3	860.7	85.5

Source: DGCI&S; (Quantity in 000' tonnes, Value in ₹ Billion)

An analysis of vegetable oil exports from India over the past three years (Table 3.7) reveals a clear leader: castor oil. Despite fluctuations in export volume, castor oil has consistently maintained its position as India's most exported vegetable oil. Following castor oil by a significant margin is groundnut oil. This trend highlights India's dominance in the global castor oil export market, potentially indicating a strategic advantage for this crop.

Table 3.7: Total Export of Vegetable Oils (2019-20 to 2021-22)

Items	2019-20		2020-21		2021-22	
	Quantity	Value	Quantity	Value	Quantity	Value
Groundnut oil	38.2	3.9	24.1	3.4	20.1	2.9
Sesame oil	8.7	1.4	8.7	2.1	7.3	1.7
Sunflower & Safflower oil	2.5	0.2	3.4	0.3	8.0	0.9
Mustard & rapeseed oil	3.8	0.5	5.4	0.8	4.8	1.0
Linseed oil	0.2	0.1	0.3	0.1	0.3	0.1
Castor oil	547.7	57.8	686.4	60.8	662.8	78.0
Cotton oil	0.5	0.0	0.1	0.0	0.1	0.0
Sal oil (fat)	2.8	0.6	1.9	0.4	1.9	0.4
Mango kernel oil	0.2	0.1	0.6	0.2	0.4	0.2
Kokum oil (fats)	0.2	0.0	0.1	0.0	0.1	0.0
Rice bran oil	12.5	1.3	9.4	1.2	6.9	1.2

Source: *DGFT / DGCIS (Quantity in 000' Tonnes, Value in Rs. Billion)*

Rapeseed meal tops the chart in terms of export quantities of oil meals over the past three years on average, followed by soybean meal, rice bran meal, and castor seed meal, while in terms of export value, soybean is on the top, followed by rapeseed, rice bran and castor (Table 3.8).

Table 3.8: Export of Oil meals (2019-20 to 2021-22)

Items	2019-20		2020-21		2021-22	
	Quantity	Value	Quantity	Value	Quantity	Value
Soybean	692.4	2185.0	1564.8	5825.4	327.7	2206.7
Groundnut	4.1	11.0	16.0	45.7	3.6	12.2
Rice Bran	236.6	330.0	575.8	756.0	749.8	983.9
Rapeseed	961.3	1540.0	1113.0	2019.2	866.4	2035.5
Castor Seed	236.6	330.0	419.9	220.0	382.4	368.8

Note: *Quantity in 000' tonnes, Value in ₹ Billion;* ***Source:*** *SEA, 2023*

CHAPTER-IV

DEMAND AND SUPPLY OF MAJOR EDIBLE OILS

DEMAND AND SUPPLY OF MAJOR EDIBLE OILS

4.1. Rising Demand for Edible Oils in India

India's domestic production of oilseeds has witnessed a steady upward trend since 2016-17, following a period of fluctuation between 2011-12 and 2015-16. This increase represents a significant growth of nearly 49% from 2015-16 to 2021-22. However, despite this progress, domestic production remains insufficient to meet the nation's ever-growing edible oil demand. As the world's second-largest consumer and leading importer of vegetable oils, India faces a unique challenge. The ongoing trend of urbanization in developing countries, including India, is expected to alter dietary habits and traditional meals particularly. This shift will likely favour processed foods, generally high in edible oil content. OECD-FAO Agricultural Outlook (2023-2032) highlighted that India, the world's biggest vegetable oil importer, is projected to maintain its high import growth to satisfy growing domestic demand. The report further emphasized that the consumption of vegetable oils for food purposes is expected to account for 57% of the total globally, driven by a growing population and rising per capita consumption in lower- and middle-income countries due to higher incomes and in emerging markets, the consumption of vegetable oil for food is set to reach levels comparable to those of wealthier economies (OECD/FAO, 2023).

Oilseed crops hold significant value in the agricultural sector, serving as the foundation for refined edible oil products. Consumers do not directly consume oilseeds; they are processed into edible oil for consumption. This escalating demand can be attributed to several key factors, including population growth, urbanization, increasing disposable income and per capita consumption, and growing awareness about health and nutrition. India's vast geographical expanse results in regional variations in oilseed availability and, consequently, the types of edible oils consumed. The ICAR-Indian Institute of Oilseeds Research (ICAR-IIOR, 2022) survey revealed distinct regional preferences in edible oil consumption across India. Mustard oil reigned supreme in India's north (61%) and east (35%) zones, followed by sunflower oil. In the west zone, soybean oil held a slight edge (28%) over mustard (25%) and sunflower (25%) oils. The south zone presented a different picture, with sunflower oil (44%) dominating, followed by groundnut oil (29%). These variations likely reflect traditional culinary practices and locally available oilseeds. Additionally, the survey underscores the influence of dietary choices. Non-vegetarians, comprising 64% of respondents, consumed an average of 14.2 kg of oil per person annually, compared to the 12.6 kg average for vegetarians. Understanding these consumption patterns and regional variations is crucial for informed policy decisions. By tailoring interventions to address specific regional preferences

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and dietary needs, India can optimize domestic oilseed production and achieve greater self-sufficiency in edible oils.

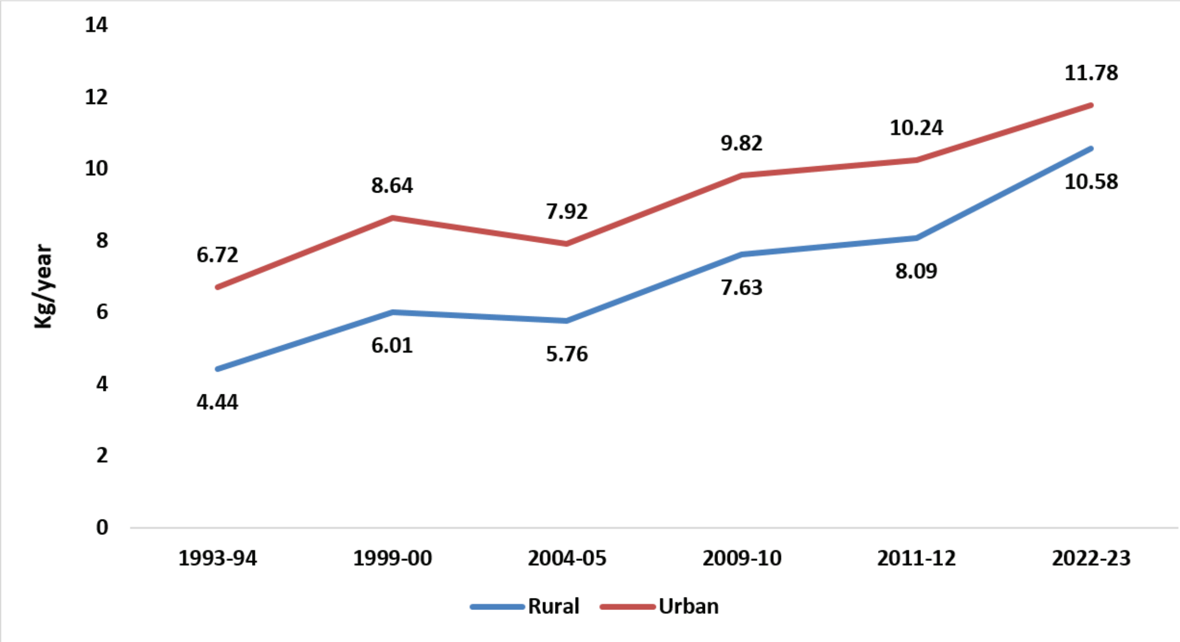
Data from the National Sample Survey Organisation (NSSO) (Table 4.1 and Figure 4.1) reveals a significant rise in household demand for edible oils across India. Per capita consumption in rural areas has nearly doubled, jumping from 4.44 kg/year in 1993-94 to 10.58 kg/year in 2022-23. Similarly, urban consumption has grown substantially, from 6.72 kg/year in 1993-94 to 11.78 kg/year in 2022-23. This trend highlights the growing importance of edible oils in the Indian diet. Interestingly, the choice of oil varies between rural and urban areas. Mustard oil reigns supreme in rural sectors, accounting for approximately 45% of consumption. In contrast, urban areas favour refined oils, such as sunflower and soybean oil, which collectively hold a 47% share. This shift towards refined oils highlights substitutions from traditional options like vanaspati and groundnut oil.

Table 4.1: Per capita consumption of different edible oils: Rural and Urban

Edible Oil	Year	Per capita consumption (kg/year)	
		Rural	Urban
Groundnut Oil	1993-1994	1.44	2.88
	1999-2000	1.44	2.76
	2004-2005	0.84	1.92
	2009-2010	0.65	1.51
	2022-2023	0.25	0.57
Refined Oil	2011-2012	2.72	4.80
Coconut Oil	2009-2010	0.19	0.21
	2011-2012	0.18	0.19
	2022-2023	0.16	0.34
Mustard Oil	1993-1994	2.04	1.80
	1999-2000	2.88	3.0
	2004-2005	2.64	2.40
	2009-2010	3.44	2.76
	2011-2012	3.65	2.90
	2022-2023	4.79	3.46
Vanaspati	1993-1994	0.36	0.72
	1999-2000	1.08	0.72
	2004-2005	0.36	0.60
	2009-2010	0.43	0.43
	2011-2012	0.24	0.25
	2022-2023	0.03	0.05
Edible Oil (Others)	1993-1994	0.60	1.32
	1999-2000	1.08	2.04
	2004-2005	1.68	3.00
	2009-2010	2.92	4.89
	2011-2012	0.83	1.13
	2022-2023	0.39	0.58

Edible Oil	Year	Per capita consumption (kg/year)	
		Rural	Urban
Edible Oil (Total)	1993-1994	4.44	6.72
	1999-2000	6.01	8.64
	2004-2005	5.76	7.92
	2009-2010	7.63	9.82
	2011-2012	8.09	10.24
	2022-2023	10.58	11.78

Source: *Author's compilation from NSSO rounds*



Source: *Author's compilation from NSSO rounds*

Figure 4.1: Per capita consumption of edible oil in kg/year: Rural and Urban (1993-2022, NSSO Rounds)

Furthermore, India's persistent demand for edible oil reveals a remarkable rise over six decades from a per capita consumption perspective. Between 1960-61 and 1980-81, consumption increased 1.2 times (from 3.2 kg/year in 1960-61 to 3.8 kg/ year in 1980-81). This growth accelerated further, reaching 2.2 times between 1980-81 and 2000-01 (from 3.8 kg/year in 1980-81 to 8.2 kg/ year annum in 2000-01), and a staggering 2.4 times from 2000-01 to recent times (8.2 kg/year in 2000-01 to 19.7 kg/year in 2020-21). This escalating demand can be attributed to many factors, including changes in income, lifestyle and evolving dietary patterns.

4.1.1 Change in Monthly Per Capita Consumption Expenditure Pattern: 1999-2000 to 2022-23

The trend in the average Monthly Per Capita Expenditure (MPCE) in India's rural and urban areas since 1999 is shown in Table 4.2. In 1999-2000, the average MPCE in rural areas was ₹486; in urban areas, it was ₹855. Over the years, there has significantly increased in average MPCE, indicating higher spending power and improved living standards. By 2022-23, the average MPCE in rural areas surged to ₹3,773; in urban areas, it reached ₹6,459 (HCES, 2022). This substantial rise reflects a notable improvement in purchasing capacity and quality of life, particularly in urban areas where the average MPCE is considerably higher.

Table 4.2: Trend in level of average monthly per capita expenditure (1999-2022): Rural and Urban

Period (NSSO)	Average MPCE over different periods (₹)	
	Rural	Urban
1999-00	486	855
2004-05	579	1,105
2009-10	1,054	1,984
2011-12	1,430	2,630
2022-23	3,773	6,459

Source: *Author's compilation from NSSO rounds and HCES, 2022*

Complementing the rise in MPCE (as shown in Table 4.2), Table 4.3 reveals a noteworthy shift in dietary patterns across India. There has been a noticeable decline in the share of consumption of cereals in both rural and urban areas of India from 1999-00 to 2022-23. In 1999-00, as shown in Table 4.3, cereals accounted for 22.23% and 12.39% of the average MPCE in rural and urban areas, respectively. However, by 2022-23, these figures dropped significantly to 4.91% in rural areas and 3.64% in urban areas. This decline suggests a shift in dietary patterns, possibly towards more diverse and processed food items. Conversely, the share of food items overall fluctuated but generally maintained a higher percentage than cereals. In 1999-00, food items constituted 59.4% and 48.06% of the average MPCE in rural and urban areas, respectively; by 2022-23, food items still constituted a significant portion of expenditure, at 46.38% in rural areas and 39.17% in urban areas. This trend indicates an evolving consumption pattern in India, with a growing preference for non-food items, possibly reflecting changes in lifestyle, income levels, and urbanization.

Table 4.3: Trend in share of consumption of cereals and food items (1999-2022): Rural and Urban

Rural		Urban	
Share of cereals in average MPCE (%)	Share of food in average MPCE (%)	Share of cereals in average MPCE (%)	Share of food in average MPCE (%)
22.23	59.4	12.39	48.06
17.45	53.11	9.63	40.51
13.77	56.98	8.16	44.39
10.75	52.9	6.66	42.62
4.91	46.38	3.64	39.17

Source: *Author's compilation from NSSO rounds and HCES, 2022*

Note: For the years 1999-00 & 2004-05, the percentage shares are based on MRP estimates and for the years 2009-10, 2011-12 and 2022-23, these are based on MMRP estimates.

Further, Table 4.4 showcases a compelling trend - a rising MPCE on edible oils in rural and urban India. From 1999-00 to 2022-23, rural MPCE on edible oils witnessed a significant jump, rising from ₹18.2 to ₹135.5. Similarly, urban areas exhibited a substantial increase, with MPCE on edible oils increasing from ₹26.8 in 1999-00 to ₹153.1 by 2022-23. This data aligns with the observed rise in overall MPCE (refer to Table 4.2) and reflects not only rising incomes but also a potential shift in dietary patterns towards higher consumption of edible oils, highlighting the critical need for strategic interventions to bridge the widening gap between domestic production and consumption of edible oils.

Table 4.4: Trend in the level of average MPCE on Edible oils (1999-2022): Rural and Urban

Period (NSSO)	MPCE of Edible Oil	
	Rural (₹)	Urban (₹)
1999-00	18.2	26.8
2004-05	25.7	36.4
2009-10	38.9	52.8
2011-12	53.5	70.0
2022-23	135.5	153.1

***Source:** Author's compilation from NSSO rounds and HCES, 2022*

4.2 Edible Oil Demand Projections

Edible oil demand projections for household consumption have been worked out following three approaches. i.e., (i) Static / Household Approach, using the population projection and the base year per capita consumption. This approach assumes short-term static behaviour of consumption, (ii) Normative Approach, based on the normative requirement as recommended by the Indian Council of Medical Research -National Institute of Nutrition (ICMR-NIN), Hyderabad and (iii) Behaviouristic Approach, which is based on changes in the behaviour of consumption on account of changing per capita income in a growing economy, measured in terms of consumption / expenditure elasticities, per capita base year consumption and income growth.

4.2.1. Static / Household Approach

In the static demand projection approach, population and base year consumption affecting the demand have been considered. The projected population growth for India, as reported by the World Bank, indicates a substantial increase from 1.41 billion in 2021 to 1.52 billion by 2030 and further to 1.66 billion by 2047. This growth trajectory signifies a significant demographic shift. The proportion of the urban population is anticipated to rise from 36% in 2023 to 51% by 2047 (Annexure- II).

The rising population is expected to continue driving edible oil demand in India. The Static/ Household Approach estimates projected demand to reach 29.8 million tons (MT) by 2030 and 32.6 MT by 2047. These projections are based on population growth forecasts and a base year per capita consumption of 19.7 kg/year, translating to a total demand of 27.7 MT in 2021.

4.2.2. Normative Approach

This approach utilizes per capita consumption recommendations provided by the ICMR-NIN to project future edible oil demand by 2047. This approach segments the population into three categories based on activity level: sedentary (20%), moderate (37%), and heavy (43%), based on research by the Indian Academy of Neurosciences. The sex ratio of 0.48 female to 0.52 male is derived from previous population data. Dietary oil requirements, obtained in grams per person per day (g/p/d) from the Working Group Report by the National Institute of Nutrition, are converted to kilograms per person per year (kg/p/year) for further analysis (Table 4.5). This methodology provides valuable insights into potential demand based on recommended consumption levels and population demographics, allowing for a comprehensive assessment of India's future edible oil needs.

Table 4.5: Dietary Requirement of Edible Oil

Age and level of physical activity		Dietary Requirement	
		g/p/d	kg/p/year
0-10 years		18.5	6.75
10-15 years old child (Female)		32.5	11.68
10-15 years old child (Male)		37.5	13.68
Females (>15 years)	Sedentary	20.0	7.30
	Moderate	25.0	9.13
	Heavy	30.0	10.95
Males (>15 years)	Sedentary	25.0	9.13
	Moderate	30.0	10.95
	Heavy	40.0	14.60

Source: *Recommended Dietary Allowance, Report of Expert Group 2020, National Institute of Nutrition*

As shown in Table 4.5, ICMR-NIN's daily edible oil intake recommendations vary by age, activity level and gender. World Bank population projections for 2021 to 2047, categorized by age group and gender (Table 4.6), are used in conjunction with the calculated oil requirements to arrive at a demand forecast. While this approach offers valuable insights for long-term edible oil security planning, it's important to acknowledge that consumption patterns may differ from recommended intake levels.

Table 4.6: Projected Population by Gender, Age Group and Activity

Year	All India population Gender, Age Group, and Activity (2021-2047, in millions)								
	0-10 years	10-15 years age Female	10-15 years age Male	Female more than 15 years of age			Male more than 15 years of age		
				Sedentary	Moderate	Heavy	Sedentary	Moderate	Heavy
2021	232	59	65	102	188	219	108	199	231
2026	224	57	63	109	201	234	115	213	247
2030	219	54	59	116	214	249	122	226	263
2036	216	53	57	122	225	262	128	237	275
2041	210	53	56	127	235	273	133	246	285
2046	202	52	55	131	243	282	137	253	294
2047	200	51	54	132	245	284	137	254	295

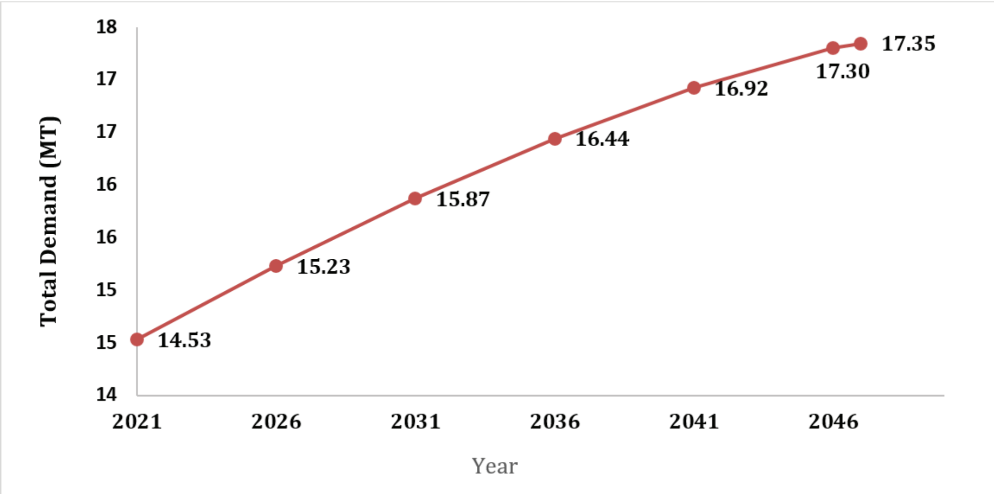
Source: *Author's computation based on World Bank population data and ICAR-NIN dietary recommendations*

Further, Table 4.7 offers a granular view of edible oil demand patterns across various demographic groups in India, revealing the evolving dynamics of dietary habits and lifestyle choices (2021 to 2047). The data showcases total edible oil consumption by age, gender, and activity level for 2021, amounting to 14.53 MT. Looking ahead, the Normative Approach projects a rise in edible oil demand to 15.87 MT by 2030 and 17.35 MT by 2047 (Figure 4.3). This disaggregated approach provides valuable insights to comprehend the specific demand patterns of different demographic groups.

Table 4.7: Projected Demand for Each Group and Total Demand (2021-2047, in MT)

Year	0-10 years of age	10-15 years of age Female	10-15 years of age Male	Demand (in MT)						
				Female more than 15 years of age			Male more than 15 years of age			
				Sedentary	Moderate	Heavy	Sedentary	Moderate	Heavy	Total
2021	1.57	0.69	0.89	0.74	1.72	2.39	0.98	2.18	3.38	14.53
2026	1.51	0.67	0.86	0.80	1.84	2.56	1.05	2.33	3.61	15.23
2030	1.48	0.63	0.81	0.85	1.96	2.73	1.11	2.48	3.84	15.87
2036	1.46	0.62	0.78	0.89	2.05	2.87	1.17	2.59	4.02	16.44
2041	1.42	0.62	0.77	0.93	2.14	2.99	1.21	2.69	4.17	16.92
2046	1.36	0.61	0.75	0.96	2.22	3.09	1.25	2.77	4.29	17.30
2047	1.35	0.60	0.74	0.97	2.23	3.11	1.25	2.78	4.31	17.35

Source: *Author's computation*



Source: *Author's computation*

Figure 4.3: Total normative demand for edible oils (2021-2047, in MT)

If the per capita consumption of edible oil recommended by the ICMR-NIN is followed, it could potentially mitigate the need to import edible oil or rely on other countries for supply. Encouraging people to adopt healthier consumption patterns aligned with the recommended levels of physical activity and age, gender, and gender-based distribution is a tribute to self-sufficiency in edible oil and improved public health outcomes. Establishing awareness campaigns and educational initiatives to promote these guidelines could play a significant role in achieving sustainable and health-conscious dietary habits for the future.

4.2.3. Behaviouristic Approach

The final approach for demand projection is the behavioural approach, which considers the changing preferences of consumers on different food items and changes in income (i.e., expenditure). The demand Equation 4.1 is given below:

$$D_t = D_o * N_t \ (1 + y * e)^t$$

Where, Dt is the household demand for a commodity in year t; D0 is the per capita consumption of the commodity in the base year, y is growth in per capita income; e is the expenditure elasticity of demand for the commodity; and Nt is the projected population in the year t. Expenditure elasticities are important parameters for projecting future demand. Expenditure elasticity varied widely across locations, income groups, and regions due to changes in production environment, tastes, and preferences.

Understanding the demand structures and consumer behaviour is critical for informing a wide range of development policies. As economic growth progresses, average per capita income typically rises, leading to a decrease in the per capita consumption of staple foods - a trend consistent with Engel's Law (1857) i.e., the proportion of income spent on food declines as average household income rises, and indicative of improved welfare. Furthermore, urbanization drives diversification within the food basket, which, as documented by Kumar (1997) and Rao (2000), enhances the quality of life by contributing to better nutritional status and overall well-being of the population. Consumer demand theory seeks to understand how rational consumers allocate a limited budget across various goods when faced with different prices. This allocation process results in a specific consumption bundle. Changes in income and relative prices lead to adjustments or diversification within this bundle, reflected by the income and price elasticities of demand for different food groups. Accurately estimating these elasticities and their projected changes is vital for future policy decisions. Consequently, the chosen estimation technique is based on a functional form that incorporates realistic assumptions about consumer behaviour, a two-stage behaviouristic food demand modelling approach, i.e., the Quadratic Almost Ideal Demand System (QUAIDS) model, builds upon the Almost Ideal Demand System (AIDS) framework (Deaton & Muellbauer 1980) by incorporating a quadratic expenditure term as it relaxes the linearity assumption of the AIDS in the expenditure function, acknowledging the potential non-linear relationship between income and expenditure. This extension allows for the modelling of non-linearities in Engel curves. Notably, the Engel curve for food exhibits log-linearity and stability both over time and across societies (Banks et al., 1997; Beatty & Larsen, 2005; Blundell et al. 1998; Leser, 1963; Yatchew, 2003). Due to their consistency with consumer theory, exact aggregation properties, and ease of estimation, AIDS-based approaches have become the preferred method for demand system estimation in the literature. The suitability of the QUAIDS framework for modelling consumer preferences has been empirically validated in numerous studies (e.g., Abdulai, 2002; Moro & Sckokai, 2000; Banks et al., 1997; Blundell & Robin, 1999; Fisher et al., 2001; Abdulai & Aubert, 2004; Gould & Villarreal, 2006; Molina & Gil, 2005; Poi, 2002, 2008, and 2012; IMF, 2016).

This framework rests on a two-stage budgeting assumption, where consumers allocate their income sequentially. In the first stage, consumers prioritize broad categories, such as food versus non-food items. This translates to a choice between the budget allocated to food and the remaining budget for all other goods and services. Consequently, the initial stage of QUAIDS involves estimating a first-step budgeting equation. Here, the focus is on how much of the total expenditure is dedicated to food, conditional on the consumption of non-food categories. The non-linear relationship between income and food expenditure, characterized by a decreasing share of income spent on food with rising income, is captured through the inclusion of a quadratic expenditure term. Notably, as the model only considers two broad expenditure categories - food and non-food - the adding-up restriction on expenditure weights allows for simplified estimation using single-equation least squares regression.

The second stage of the QUAIDS model delves into the intra-food allocation decisions. Here, consumers make simultaneous choices regarding allocating their total food expenditure across specific food items. This stage translates to estimating a system of simultaneous equations within the QUAIDS framework, with each equation representing the demand for a specific food item category. While independent demand equations for individual food items may seem intuitive, can overlook crucial substitution and complementarity effects between different food products. These effects can significantly impact the demand for specific items. To address this limitation, a system of equations approach is employed within the broader food category and allows for estimating demand for various food items while accounting for their interdependencies. The two-stage budgeting framework, therefore, leverages reasonable assumptions about consumer behaviour. These assumptions include the separability of choices regarding food versus non-food consumption and the separability of choices within the food category itself. This approach balances these simplifications with the ability to capture important characteristics of demand for individual food items through the system of equations.

The two-stage QUAIDS model employed here estimates food expenditure elasticity for specific food items. This elasticity measures the responsiveness of consumer demand (expenditure) for an item to changes in their total food budget. In simpler terms, it reflects the perceived importance of that specific item within consumers' food baskets.

While significant shifts in consumption expenditure and dietary patterns have likely occurred in the past decade, existing elasticity estimates lack this crucial update. To address this gap, this model adopts an alternative approach. It leverages Private Final Consumption Expenditure (PFCE) data for the period 2013-14 to 2021-22 alongside Consumer Price Index (CPI) data from the same timeframe. This combined dataset allows us to estimate demand/ expenditure elasticities for different food items, capturing the recent changes in consumption expenditure patterns and their impact on edible oil demand. While not a direct replacement for HCE data, this approach offers valuable insights into the evolving dynamics of edible oil consumption in India.

The above data set categorizes expenditure on food into six key groups reflecting the Indian household consumption basket: Cereals and Pulses (c1)1[4], Eggs, Fish, and Meat (c2), Milk and Milk products (c3), Vegetables and Fruits (c4), Oils and Fats (c5)[5] and Others (i.e., Sugar, jam, honey, chocolate, confectionery and non-alcoholic beverages which include coffee, tea and cocoa, mineral waters, soft drinks, fruit, and vegetable juices, etc.) (c6). This categorization aligns with the available data but presents limitations, as data for cereals and pulses is combined. Similarly, data for oils and fats is not disaggregated within PFCE and CPI. Future research efforts could benefit from more granular data on these categories to improve elasticity estimates, particularly for edible oils.

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4. Since PFCE data is not available for cereals and pulses separately

5. Since PFCE and CPI data is not available for Oils and Fats separately, which is limitation of this study as expenditure elasticity has been measured for Oils and fats altogether not edible oils separately

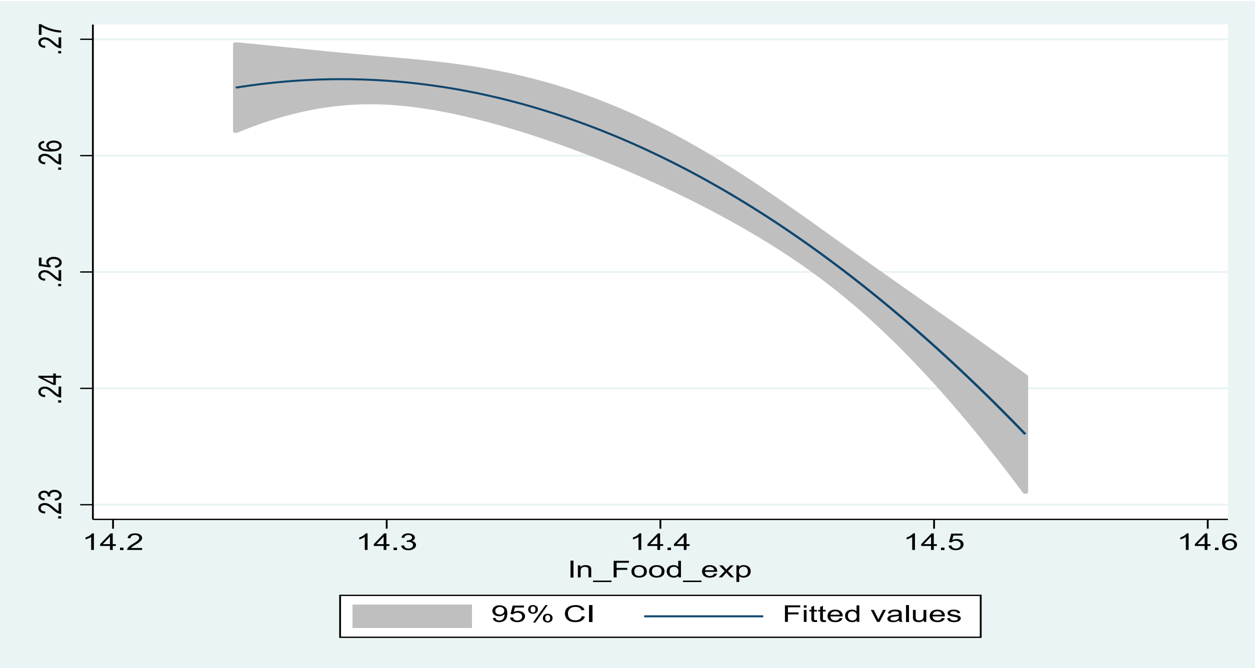
The estimated expenditure elasticities, categorized by food groups in Table 4.8, offer valuable insights into consumer spending patterns. These elasticities, based on total food expenditure, allow for the classification of food groups into three distinct categories. The first category encompasses 'high-income elasticity products', including milk and milk products (i.e., 1.6), eggs, fish and meat (i.e., 1.3), and "Others" (sugar, sweets, and non-alcoholic beverages) (i.e., 1.7). These groups exhibit elasticity greater than 1, indicating that a rise in total food expenditure will lead to a proportionally larger increase in spending on these items. Notably, while oils and fats belong to this category, their elasticity is the lowest at just above 1 (1.1), indicating a less pronounced increase in expenditure compared to other products in this group. The second category consists of 'unit income elasticity products', including fruits and vegetables (i.e., 1.0). For these items, expenditure is expected to rise at a rate comparable to the overall increase in food spending. Finally, the third category comprises 'less-than-unity income elasticity products', primarily cereals and pulses (i.e., 0.3). These staples are likely to see a slower rise in expenditure relative to the growth in total food spending.

Table 4.8: Food Expenditure Demand Elasticities: Second Budgeting Stage

Expenditure elasticity: with respect to total expenditure on food	
c1: Cereals and pulses	0.3
c2: Egg, Fish, and meat	1.3
c3: Milk and milk products	1.6
c4: Vegetables and Fruits	1.0
c5: Oils and fats	1.1
c6: Others (Sugar, jam, honey, chocolate, confectionery, and non-alcoholic beverages, which include Coffee, tea and cocoa, Mineral waters, soft drinks, fruit, and vegetable juices, etc.)	1.7

Source: *Authors' estimation*

Engel's Law posits a declining income share dedicated to food as incomes rise, and our data (Tables 4.3 and 4.4) corroborates this notion. Expenditure on staples like cereals and pulses exhibits a less-than-unity income elasticity, signifying a proportional decrease in consumption with increasing income (Figure 4.4). This trend resonates with Bennett's Law (1941), reflecting a shift away from calorie-dense staples towards more nutrient-rich and higher-value foods as incomes improve (Figures 4.5 to 4.8). Furthermore, our findings coincide with India's rising personal income and urbanization over the past decade. These factors likely influence households to purchase more processed and packaged foods, potentially impacting overall dietary patterns. Understanding these evolving consumption patterns, with a growing demand for diverse food options, is essential for informing future policy decisions. By recognizing this shift, specific policies can be envisioned that promote balanced dietary choices, boost domestic production of essential food groups, and ensure long-term food security for the nation.

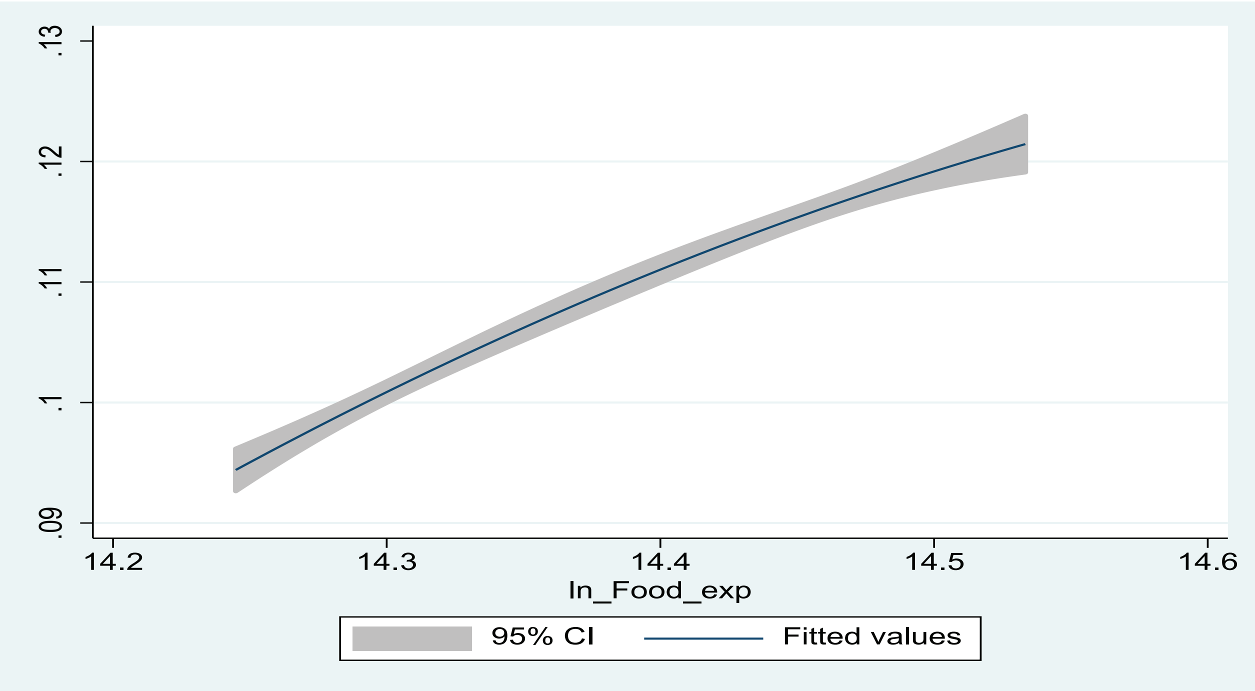


X-axis: Logarithm of total expenditure on food

Y-axis: Cereals and pulses: predicted weight in the total food budget

Source: *Authors' estimation*

Figure 4.4: Predicted Cereals and pulses expenditure weights with total expenditure on food

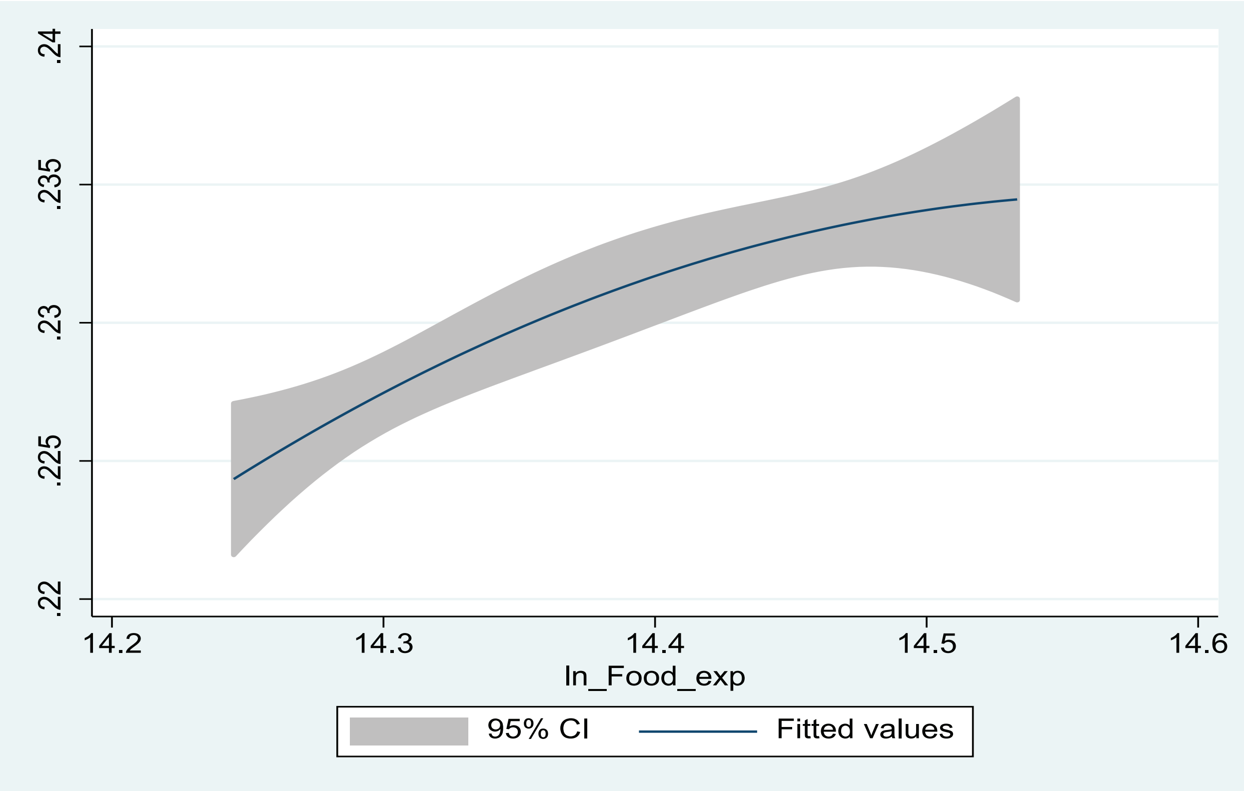


X-axis: Logarithm of total expenditure on food

Y-axis: Egg, Fish, and meat: predicted weight in the total food budget

Source: *Authors' estimation*

Figure 4.5: Predicted Egg, Fish, and meat expenditure weights with total expenditure on food

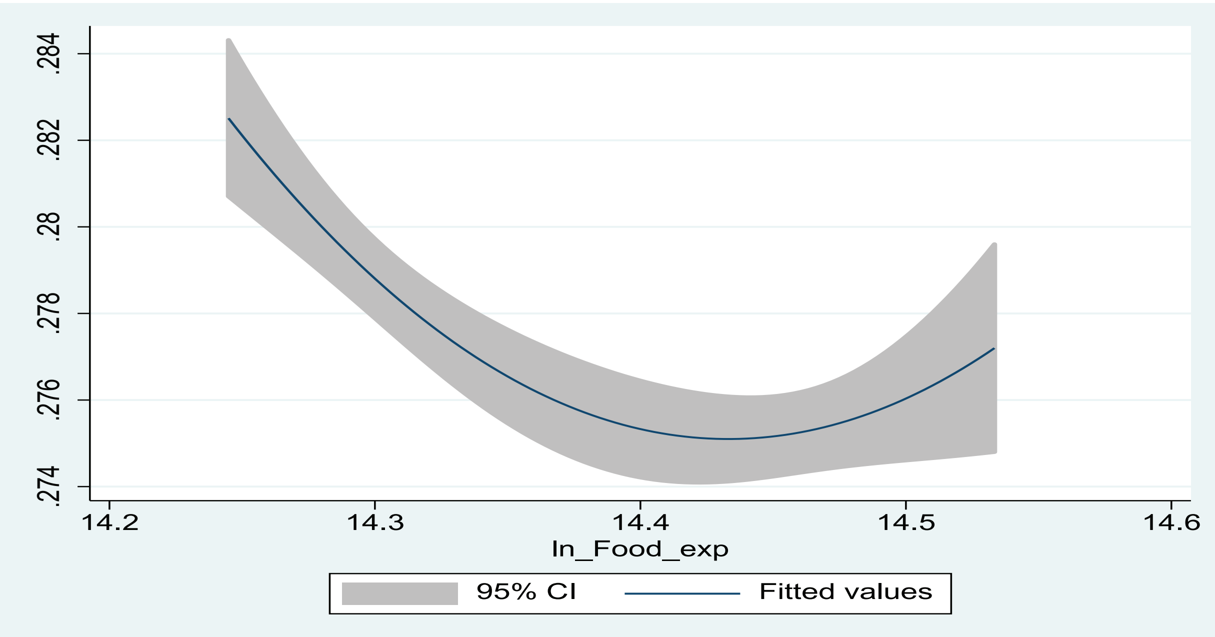


X-axis: Logarithm of total expenditure on food

Y-axis: Milk and milk products: predicted weight in the total food budget

Source: *Authors' estimation*

Figure 4.6: Predicted Milk and milk products expenditure weights with total expenditure on food

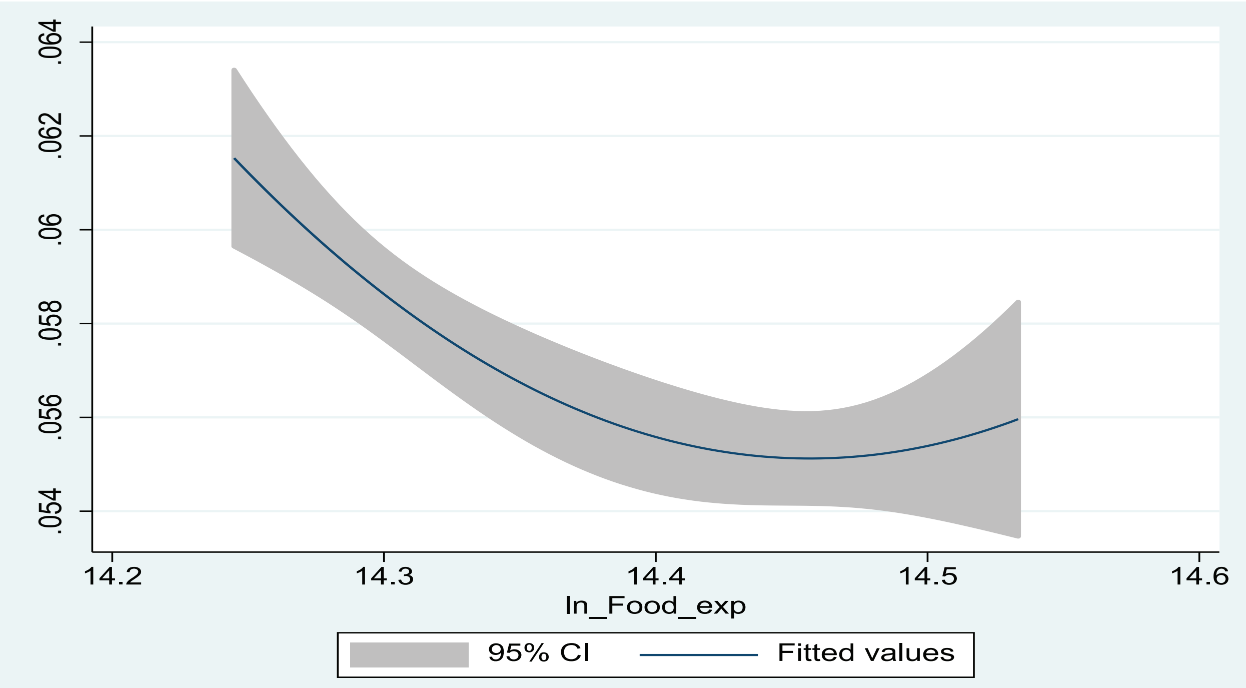


X-axis: Logarithm of total expenditure on food

Y-axis: Vegetables and Fruits: predicted weight in the total food budget

Source: *Authors' estimation*

Figure 4.7: Predicted Vegetables and Fruits expenditure weights with total expenditure on food

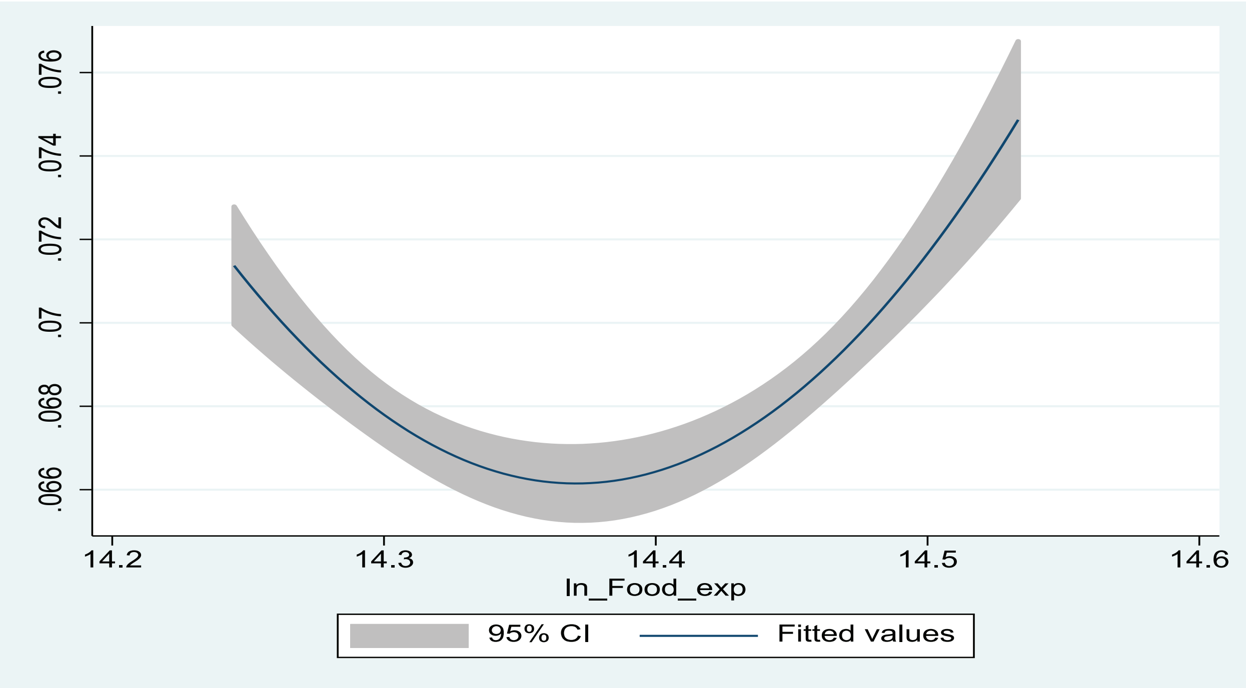


X-axis: Logarithm of total expenditure on food

Y-axis: Oils and fats: predicted weight in the total food budget

Source: *Authors' estimation*

Figure 4.8: Predicted Oils and fats expenditure weights with total expenditure on food



X-axis: Logarithm of total expenditure on food

Y-axis: Others (Sugar, jam, honey, chocolate, and confectionery + Non-alcoholic beverages which include Coffee, tea and cocoa, Mineral waters, soft drinks, fruit, and vegetable juices, etc): predicted weight in the total food budget

Source: *Authors' estimation*

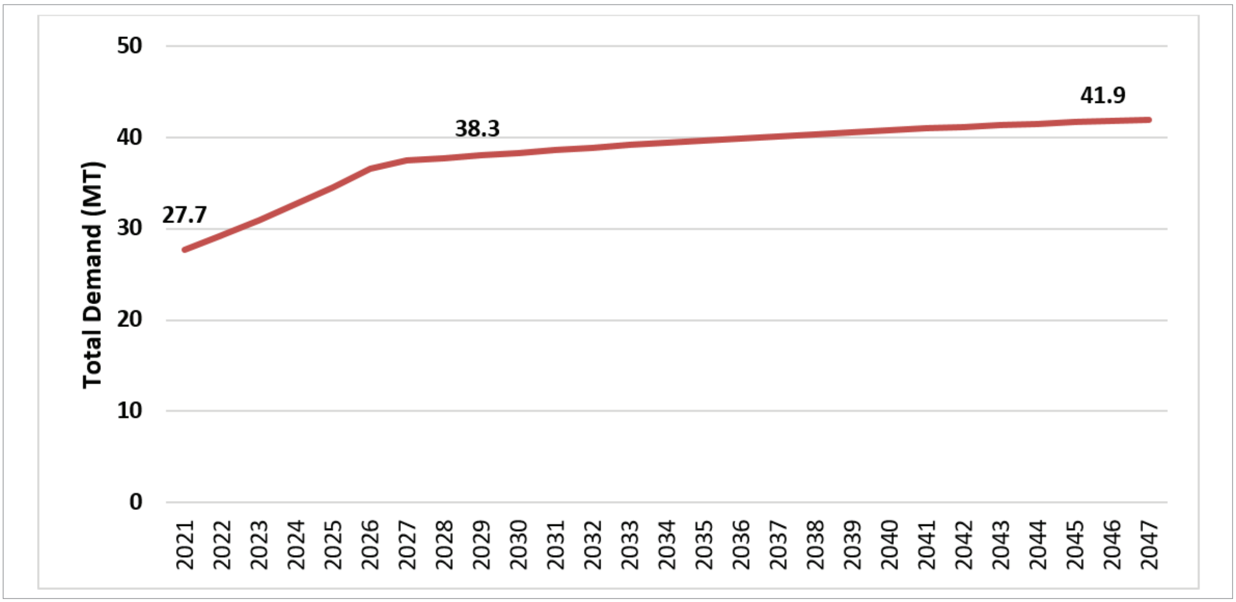
Figure 4.9: Predicted others expenditure weights with total expenditure on food

This analysis employs a two-scenario framework to explore potential future trends in edible oil consumption in India. Given growing concerns about excessive consumption highlighted by organizations like the National Institute of Nutrition (NIN) and the World Health Organization (WHO), these scenarios serve as consumption caps to assess future demand trajectories. Scenario I reflect the average consumption observed in developed countries (25.3 kg/person/year) based on OECD/FAO Agricultural Outlook (2023). Scenario II, representing the highest consumption level, considers the United States at 40.3 kg/person/year. It's important to note that these figures represent vegetable consumption in food only, excluding industrial usage.

These scenarios are then integrated into the demand estimation Equation (4.1) to project future edible oil demand. The calculations utilize a base consumption level of 19.7 kg/person/year, a per capita income growth rate of 4.37% based on the Business as Usual (BAU) scenario (reflecting the average Net National Income (NNI) per capita growth at constant prices over the past decade), and an expenditure elasticity of edible oil derived from the two-stage QUAIDS model.

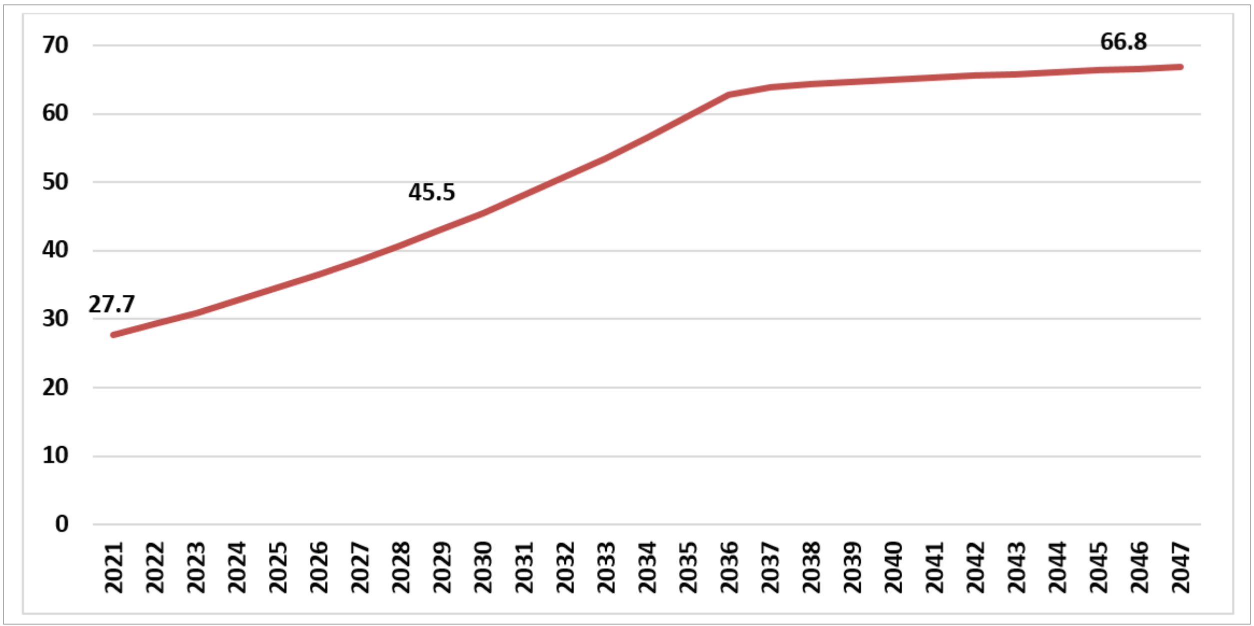
The two-scenario framework employed here clearly shows India's potential edible oil demand trajectory. Under Scenario-I, which reflects the average consumption level in developed countries (25.3 kg/person/year), edible oil demand is projected to reach 38.3 MT by 2030 and 41.9 MT by 2047 (Figure 4.10). Scenario-II, representing the highest consumption level observed (40.3 kg/person/year in the United States), estimates a demand of 45.5 MT by 2030 and a staggering 66.8 MT by 2047 (Figure 4.11). Furthermore, the analysis suggests that India's per capita consumption is expected to reach the Scenario-I level (25.3 kg/person/year) by 2028 and the Scenario-II level (40.3 kg/person/year) by 2038.

Considering India's aspirations of becoming a developed nation by 2047, this analysis additionally explores edible oil demand under a High-Income Growth (HIG) scenario. To achieve this ambitious target, economic growth acceleration to 7.6-9.0% is projected to be necessary (RBI, 2023; PTI, 2023). In this HIG scenario, assuming an estimated 8% annual per capita NNI growth, India's edible oil demand is expected to reach a level of 25.3 kg/person/year (Scenario-I) as early as 2025. This represents a three-year advancement compared to the Business-As-Usual (BAU) situation. Furthermore, under the HIG scenario, demand is projected to reach 40.3 kg/person/year (Scenario-II) by 2031, which is seven years earlier than anticipated in the BAU situation. These projections highlight the significant impact that rapid economic growth can have on edible oil demand in India. It's important to note that these figures of developed nations represent vegetable consumption in food only, excluding industrial usage.



Source: Authors' estimation

Figure 4.10: Scenario-II: Total Demand for Edible Oil (MT)



Source: Authors' estimation

Figure 4.11: Scenario-I: Total Demand for Edible Oil (MT)

4.3. Edible Oil Supply Projections to 2030 and 2047

A comprehensive approach utilizing various models and techniques was employed to forecast India's edible oil supply under a BAU scenario. Historical data on oilseed production, obtained from the Ministry of Agriculture and Farmers Welfare (MoA&FW) for primary sources of edible oil and 'Agriculture Statistics at a Glance' reports for secondary sources, served as the foundation for this analysis. Univariate time series analysis formed the core, with models like Autoregressive Integrated Moving Averages (ARIMA), Generalized

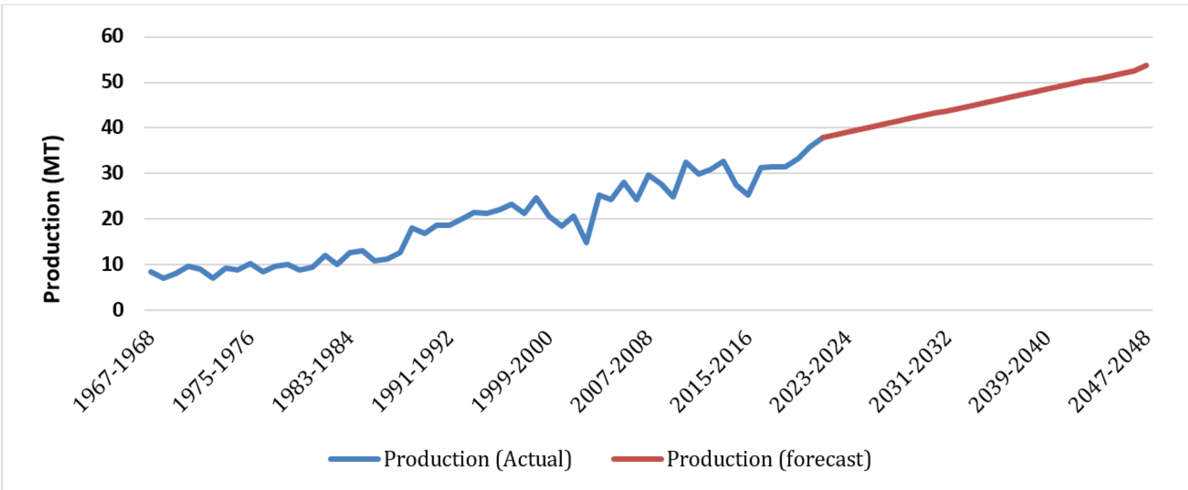
Regression Neural Networks (GRNN), Extreme Learning Machines (ELM), and trend regressions (linear and quadratic) applied to the data. Additionally, Holt's Smoothing Techniques, Geometric Mean Growth Rate (GMGR), and Average Annual Growth Rate (AAGR) were utilized. The model demonstrating the best fit or producing the least error for each specific case was then chosen to forecast oilseed production up to the year 2047.

This study expands upon existing oil crops production forecasts in India by delving deeper than aggregate historical data. While conventional methods focus solely on aggregate production, our approach takes a more granular look. We employ forecasting techniques not only on the aggregate level data for nine major oilseeds (groundnut, soybean, rapeseed & mustard, sunflower, sesame, nigerseed, safflower, castor, and linseed), but also on individual forecasts for each of these oilseeds. Furthermore, forecasts are generated for five secondary oils (palm oil, coconut oil, cottonseed oil, rice bran oil, and solvent-extracted oils & TBOs). This multi-tiered forecasting approach offers valuable insights into the future production potential of various oil crops across India.

The following sections present comprehensive national-level projections for India's edible oil supply until 2047. This analysis is categorized to provide granular insights for informed policy decisions. First, we present aggregated projections for total production of nine primary oilseeds. Following this, disaggregated national-level projections are provided for the individual production of each of these nine primary oilseeds. Finally, the analysis offers national-level projections for the individual production of five secondary oils.

4.3.1. National Level Projected Production of Nine Primary Oilseeds (based on aggregated data) by 2030 and 2047

The Extreme Learning Machines (ELM) neural network model emerged as the most suitable method for forecasting national-level production of nine primary oilseeds. This model leveraged historical data from the period 1967-68 to 2021-22. The forecast suggests a steady increase in production, reaching an estimated 43.2 MT by 2030 and 53.7 MT by 2047 (Figure 4.12), up from 37.96 MT in 2021-22.

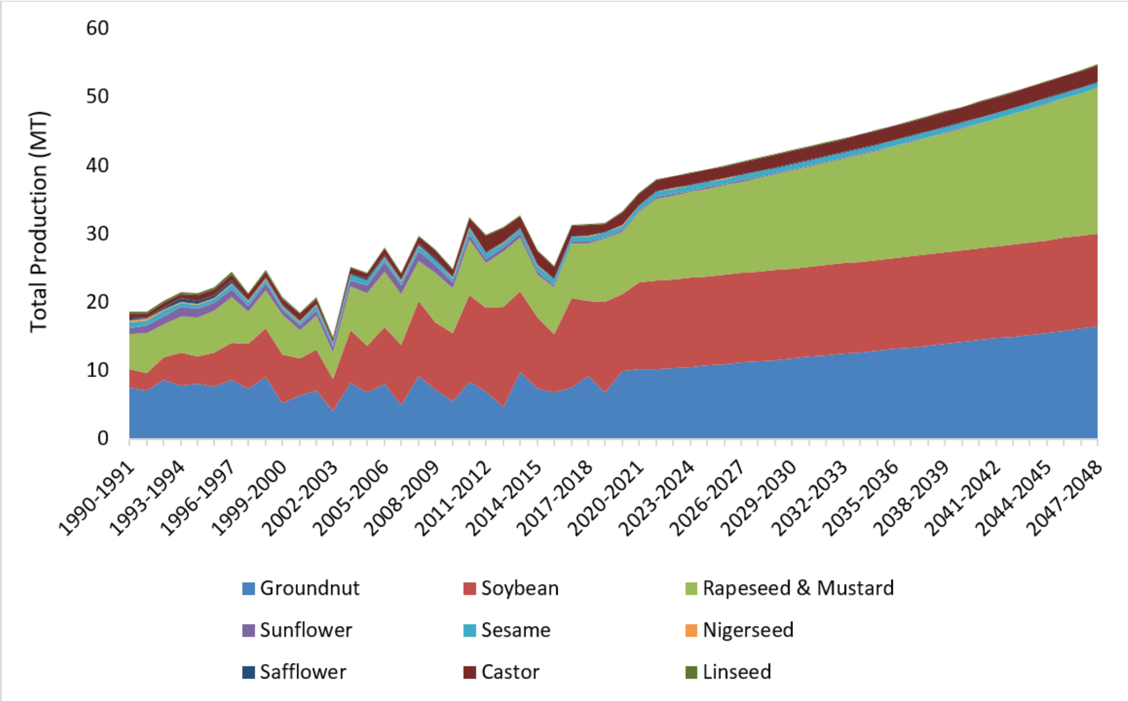


Source: *Authors' estimation based on data retrieved from MoA&FW*

Figure 4.12: National Forecasted Primary Oilseeds Production (Based on Aggregate Level Data of Nine Oilseeds 1967- 2045)

4.3.2. National Level Projected Production of Nine Primary Oilseeds individually (based on Crop-wise data) by 2030 and 2047

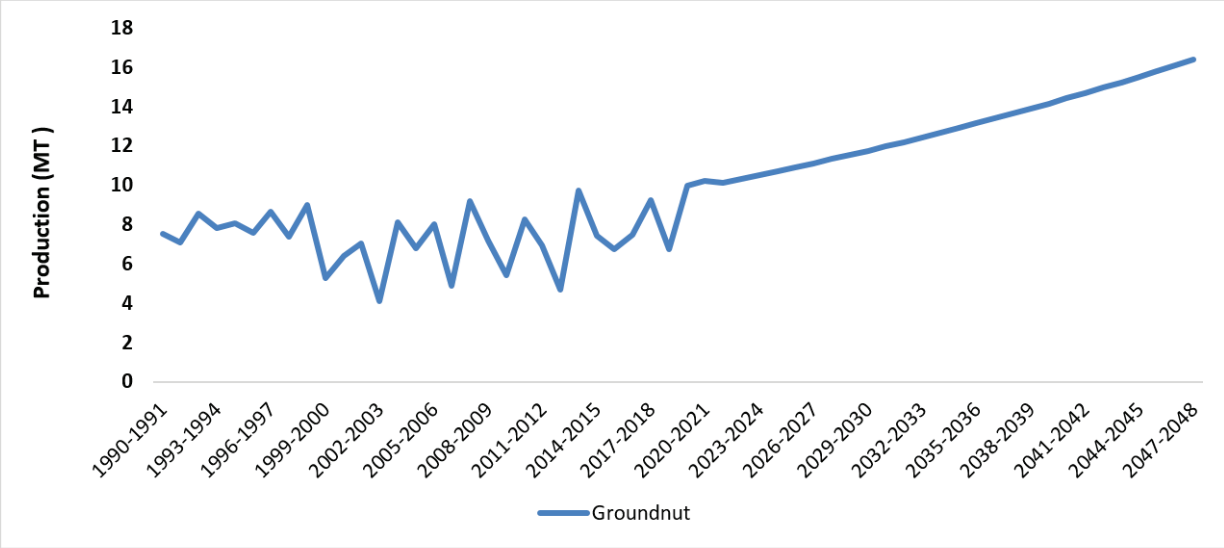
Building upon the methodology outlined in Section 3.3, this analysis presents disaggregated forecasts for individual primary oilseed production in India. Due to data inconsistencies, the forecasting period for these individual oilseeds spans 1990-91 to 2021-22. Despite this timeframe variation, the aggregated production estimates derived from these individual forecasts (i.e., 42.8 MT by 2030 and 54.8 MT by 2047) closely align with the projections based on the aggregate data (Figure 4.13). This convergence strengthens the validity of both sets of estimations.

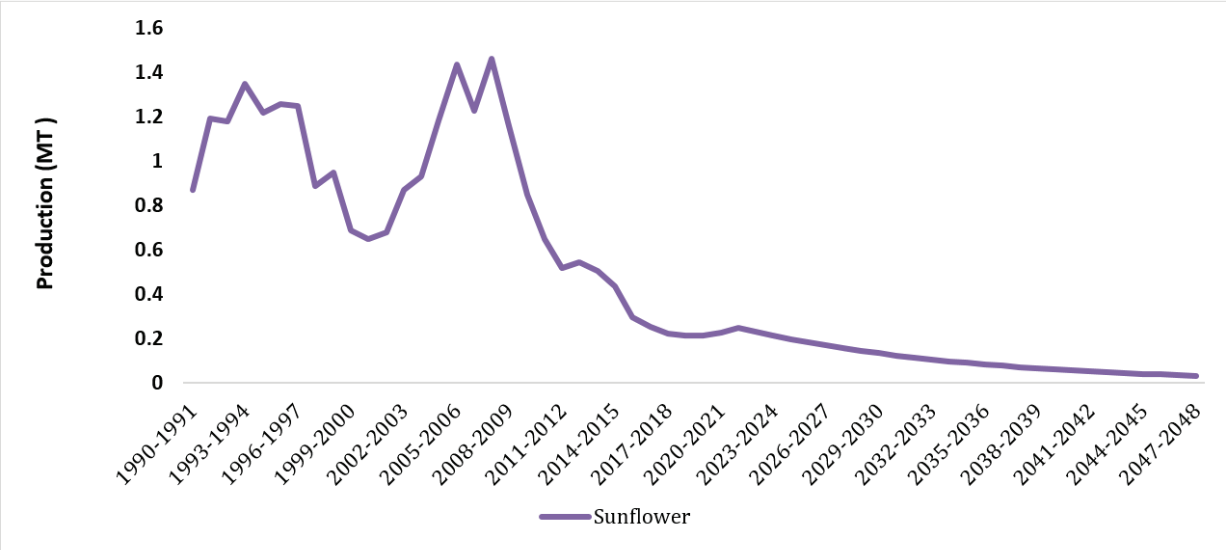


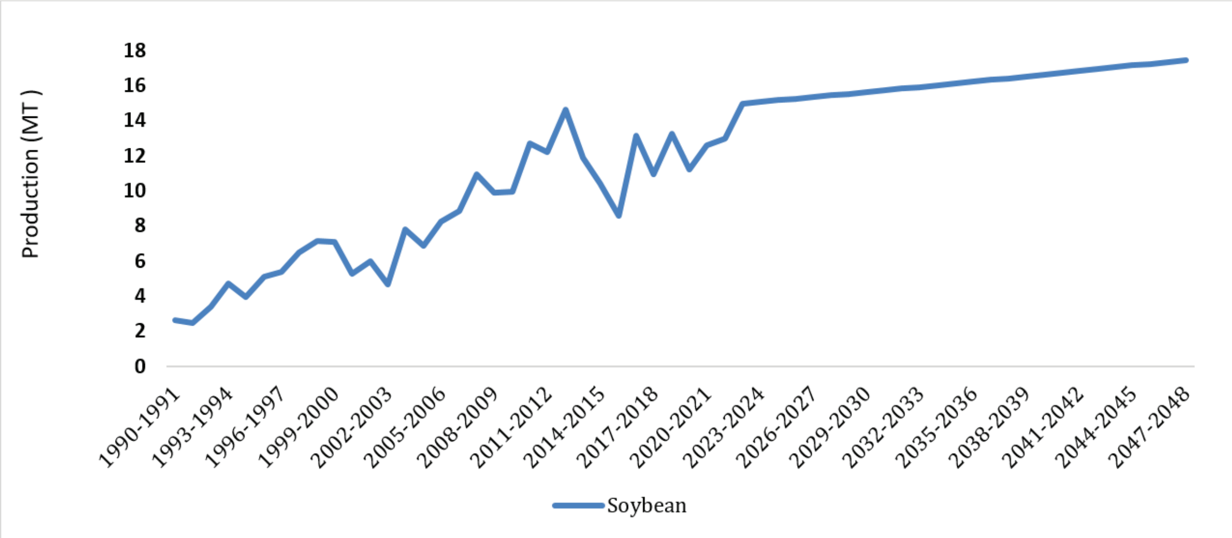
Source: *Authors' estimation based on data retrieved from MoA&FW*

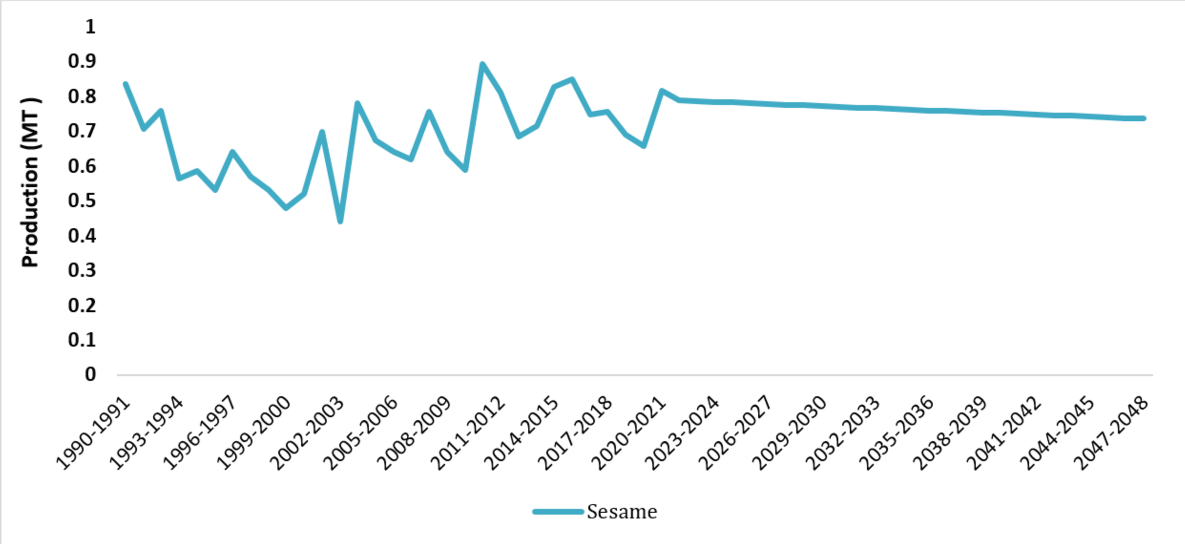
Figure 4.13: Forecasted Primary Oilseeds Production by each Oil Seeds

For a more detailed understanding of future production potential, individual crop-wise projections for each of the nine primary oilseeds until 2047 are given in Figure 4.14. These disaggregated forecasts empower the development of targeted interventions that address the specific production challenges and opportunities associated with each oilseed variety. By strategically allocating resources and implementing tailored support measures, India can work towards optimizing the production potential of all nine oilseeds.

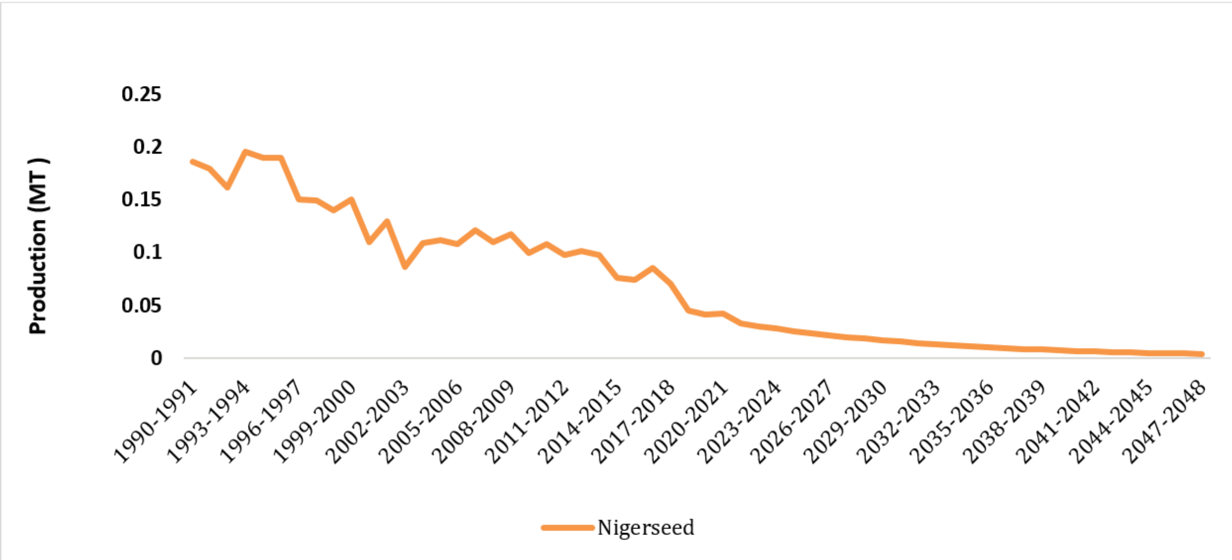

Production (MT)
18
16
14
12
10
8
6
4
2
0
1990-1991
1993-1994
1996-1997
1999-2000
2002-2003
2005-2006
2008-2009
2011-2012
2014-2015
2017-2018
2020-2021
2023-2024
2026-2027
2029-2030
2032-2033
2035-2036
2038-2039
2041-2042
2044-2045
2047-2048
Groundnut


Production (MT)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1990-1991
1993-1994
1996-1997
1999-2000
2002-2003
2005-2006
2008-2009
2011-2012
2014-2015
2017-2018
2020-2021
2023-2024
2026-2027
2029-2030
2032-2033
2035-2036
2038-2039
2041-2042
2044-2045
2047-2048
Sunflower

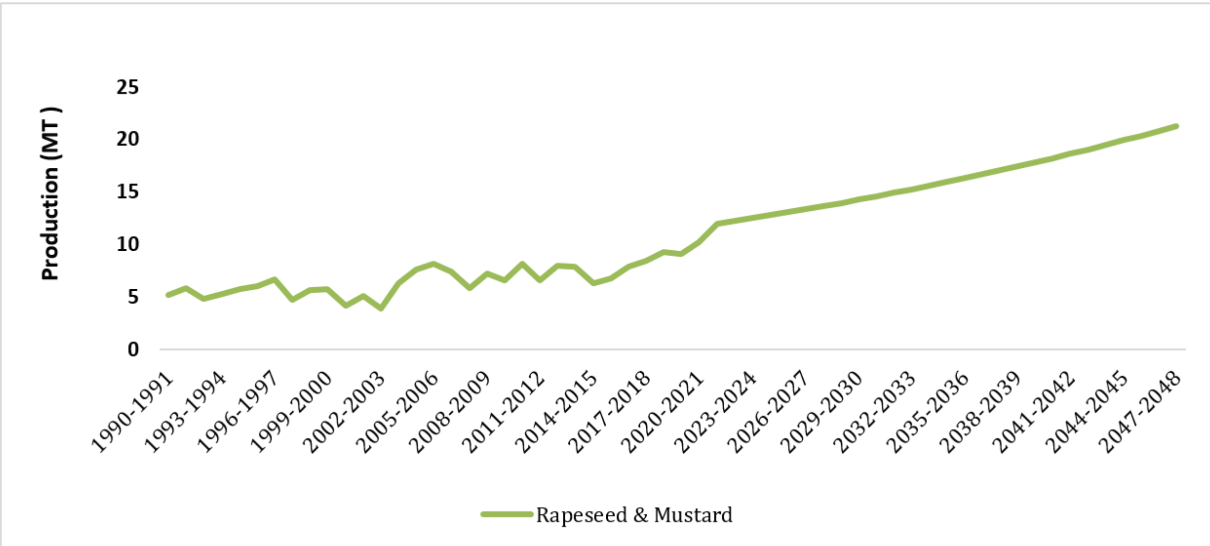

Production (MT)
18
16
14
12
10
8
6
4
2
0
1990-1991
1993-1994
1996-1997
1999-2000
2002-2003
2005-2006
2008-2009
2011-2012
2014-2015
2017-2018
2020-2021
2023-2024
2026-2027
2029-2030
2032-2033
2035-2036
2038-2039
2041-2042
2044-2045
2047-2048
Soybean



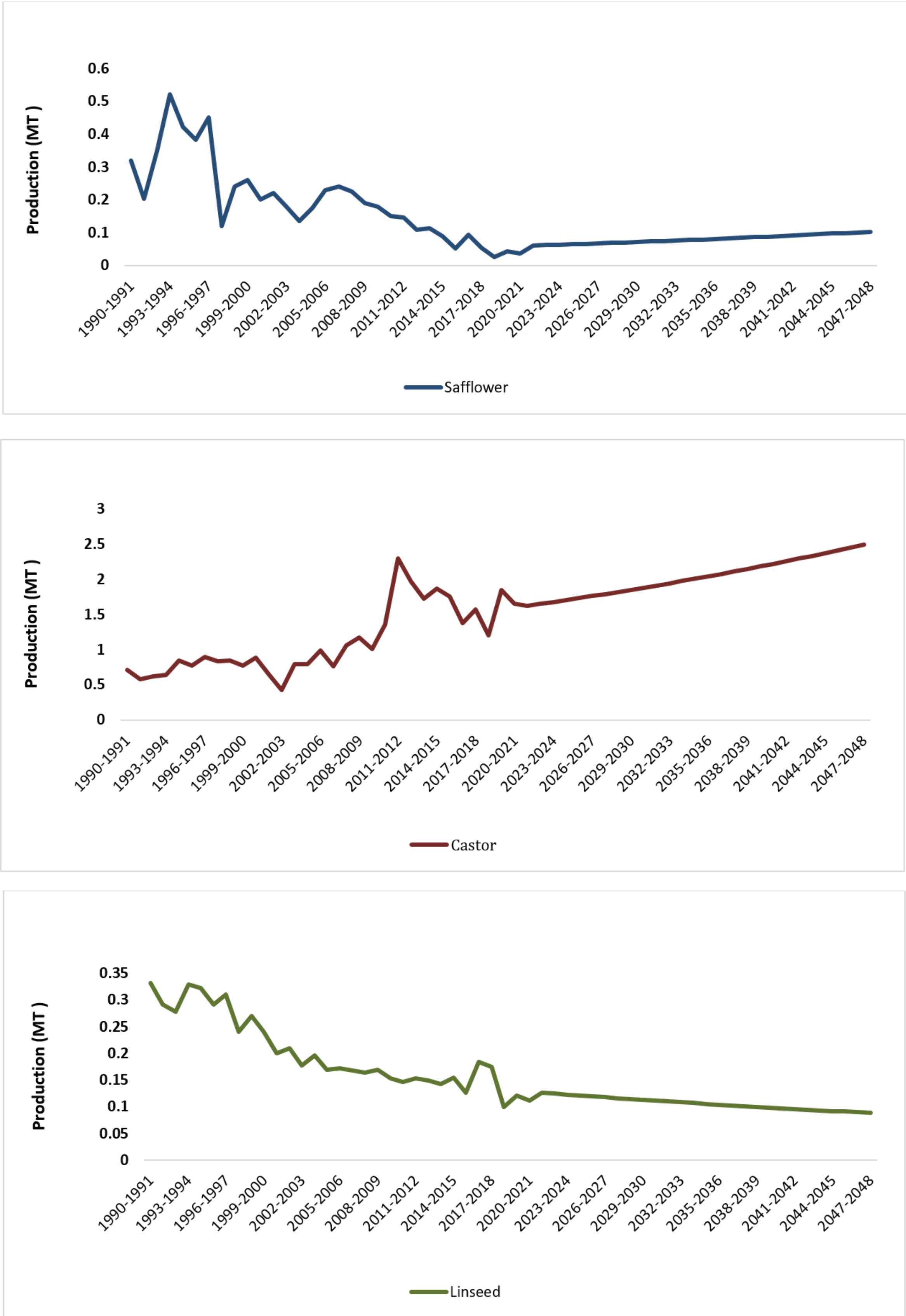
Production (MT)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1990-1991
1993-1994
1996-1997
1999-2000
2002-2003
2005-2006
2008-2009
2011-2012
2014-2015
2017-2018
2020-2021
2023-2024
2026-2027
2029-2030
2032-2033
2035-2036
2038-2039
2041-2042
2044-2045
2047-2048
Sesame



Production (MT)
0.25
0.2
0.15
0.1
0.05
0
1990-1991
1993-1994
1996-1997
1999-2000
2002-2003
2005-2006
2008-2009
2011-2012
2014-2015
2017-2018
2020-2021
2023-2024
2026-2027
2029-2030
2032-2033
2035-2036
2038-2039
2041-2042
2044-2045
2047-2048
Nigerseed



Production (MT)
25
20
15
10
5
0
1990-1991
1993-1994
1996-1997
1999-2000
2002-2003
2005-2006
2008-2009
2011-2012
2014-2015
2017-2018
2020-2021
2023-2024
2026-2027
2029-2030
2032-2033
2035-2036
2038-2039
2041-2042
2044-2045
2047-2048
Rapeseed & Mustard

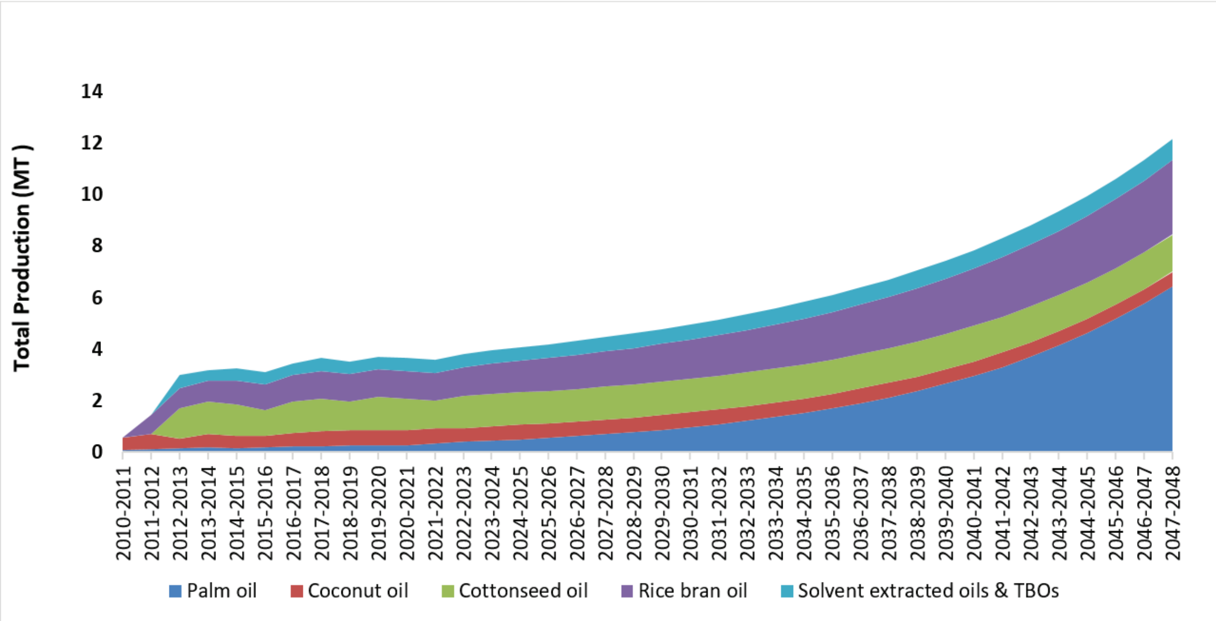


Source: Authors' estimation based on data retrieved from MoA&FW

Figure 4.14: National Forecasted Primary Oilseed Production (1990-2047)

4.3.3. National Level Projected Production of Five Secondary Oils individually (based on crop-wise data) by 2030 and 2047

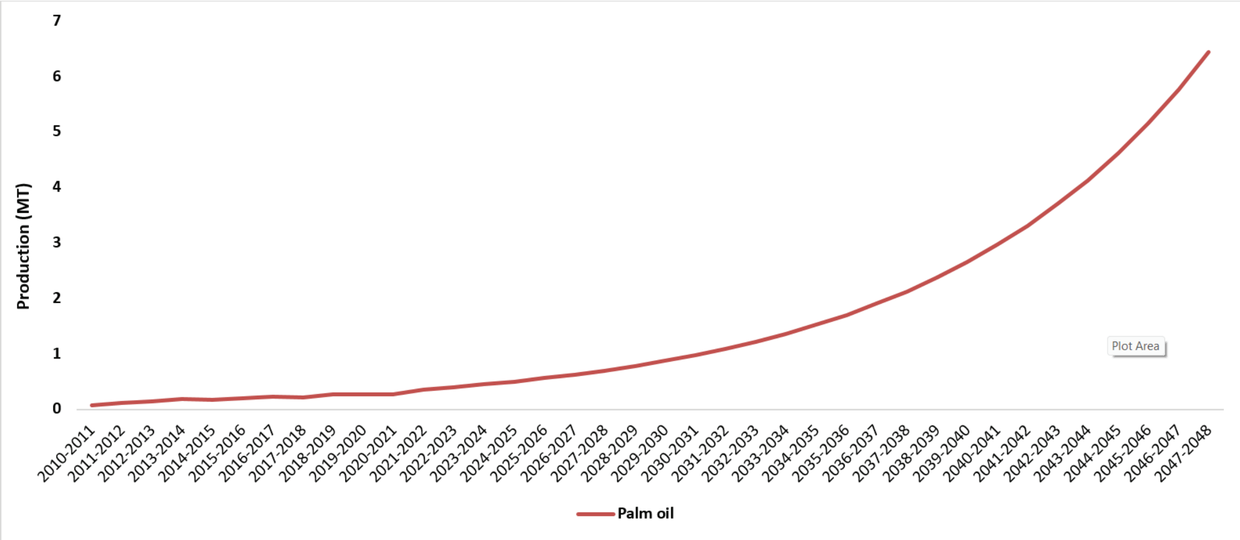
The analysis extends to individual forecasts for five secondary oils: palm oil, coconut oil, cottonseed oil, rice bran oil, and solvent-extracted oils & TBOs. Employing data from 2010-11 to 2021-22, the forecasts predict a steady rise in production, with the aggregate reaching an estimated nearly 5 MT by 2030 and 12.14 MT by 2047 (Figure 4.15). This represents a significant increase from the 3.6 MT production level recorded in 2021-22. These projections, while positive, highlight the potential for further growth in the secondary oilseed sector. By implementing targeted policies to incentivize investment, improve cultivation practices, and address logistical bottlenecks, India can capitalize on this potential and diversify its domestic edible oil production base.

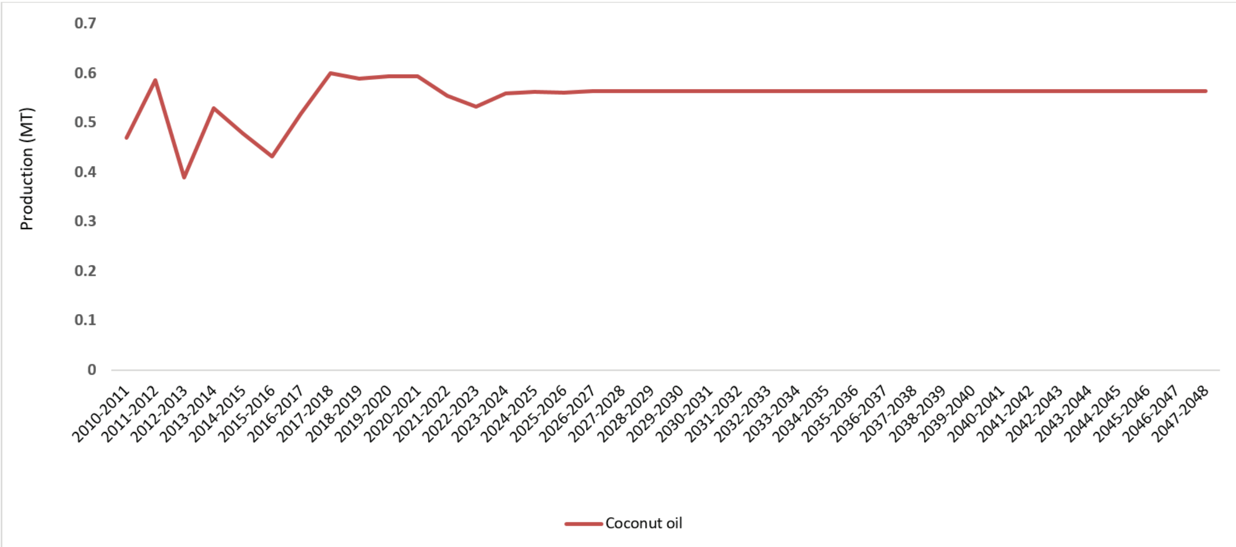


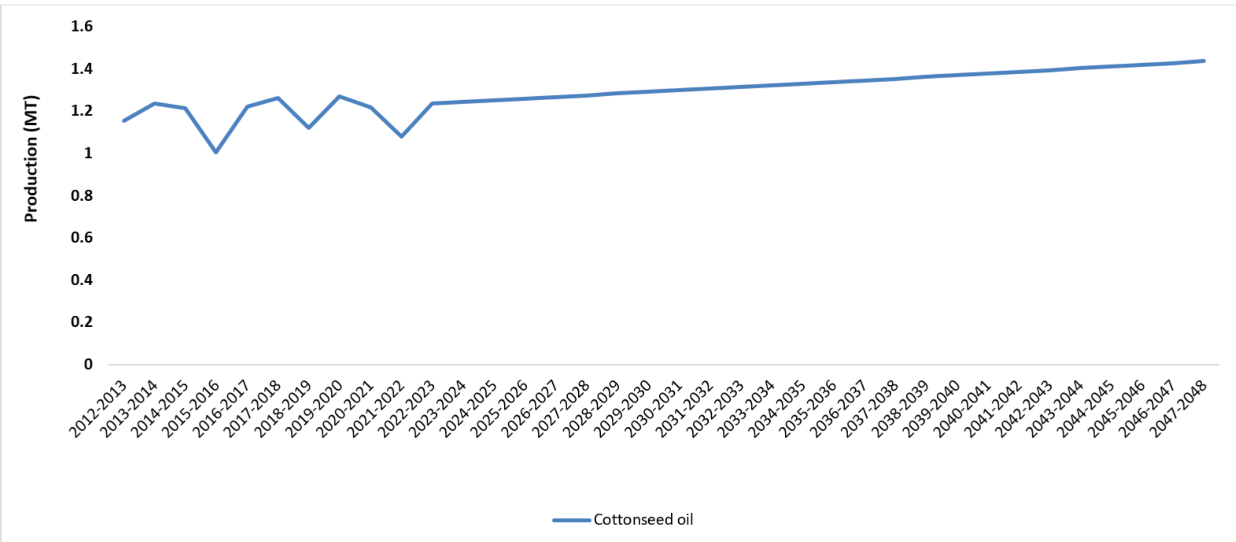
Source: Authors' estimation based on data retrieved from MoA&FW

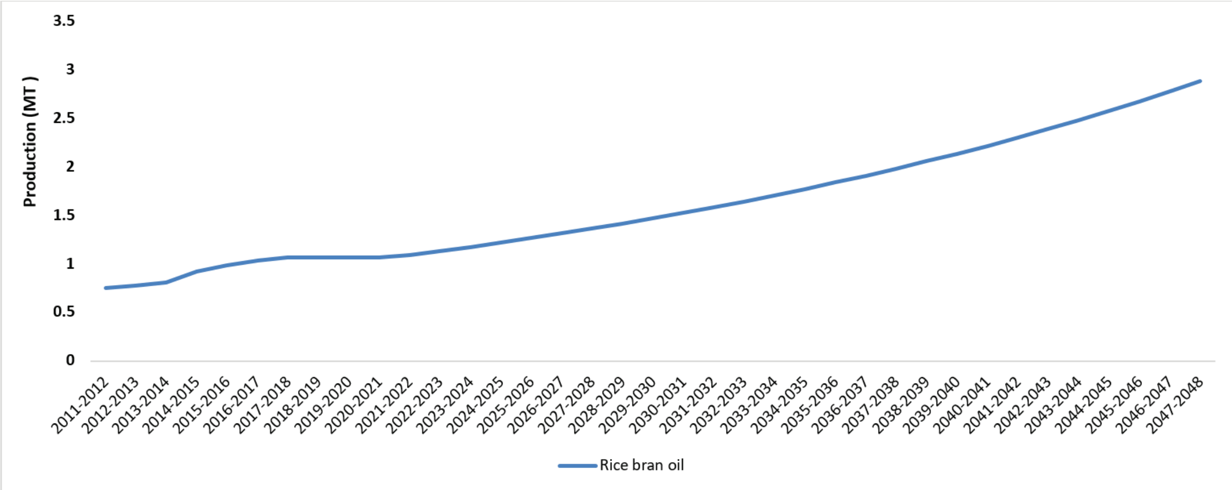
Figure 4.15: National Forecasted Secondary Oils Production by each Oil

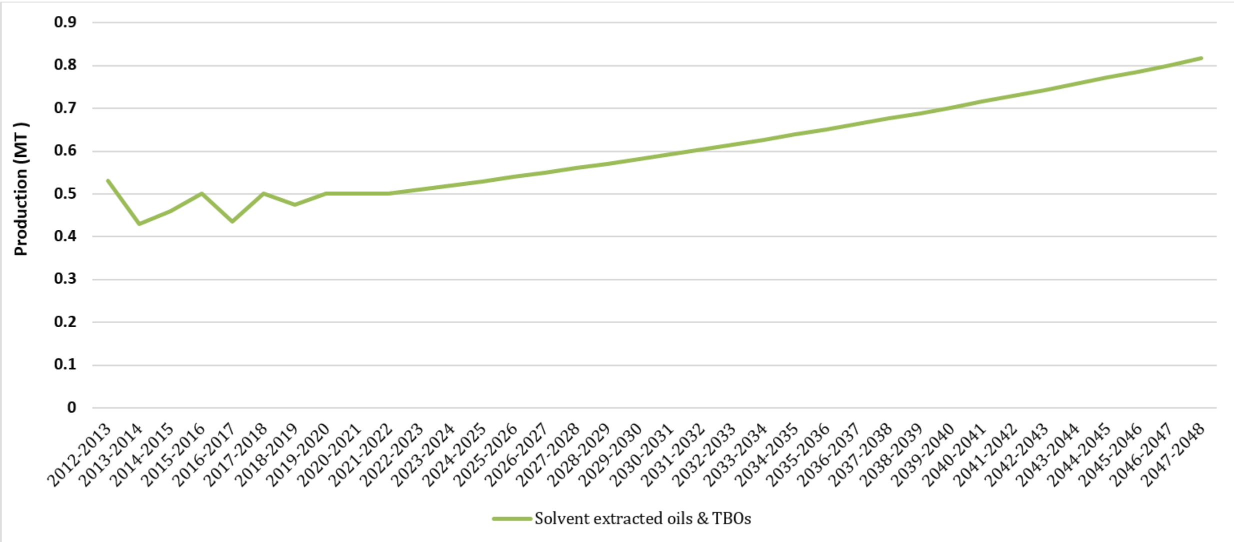
For a more nuanced understanding of future edible oil production trends, individual projections for each of the five secondary oils (palm oil, coconut oil, cottonseed oil, rice bran oil, and solvent extracted oils & TBOs) are presented in Figures 4.16. These disaggregated forecasts provide valuable insights into the anticipated production trajectories of each secondary oil variety. These trends alongside the overall secondary oil production forecast and the primary oilseed projections may help to craft a comprehensive strategy to strengthen domestic edible oil production. This multi-layered approach further benefits addressing the specific opportunities and challenges associated with each oil crop, promoting a robust domestic oil production system in India.


Production (MT)
7
6
5
4
3
2
1
0
Plot Area
2010-2011 2011-2012 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2018-2019 2019-2020 2020-2021 2021-2022 2022-2023 2023-2024 2024-2025 2025-2026 2026-2027 2027-2028 2028-2029 2029-2030 2030-2031 2031-2032 2032-2033 2033-2034 2034-2035 2035-2036 2036-2037 2037-2038 2038-2039 2039-2040 2040-2041 2041-2042 2042-2043 2043-2044 2044-2045 2045-2046 2046-2047 2047-2048
Palm oil


Production (MT)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2010-2011 2011-2012 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2018-2019 2019-2020 2020-2021 2021-2022 2022-2023 2023-2024 2024-2025 2025-2026 2026-2027 2027-2028 2028-2029 2029-2030 2030-2031 2031-2032 2032-2033 2033-2034 2034-2035 2035-2036 2036-2037 2037-2038 2038-2039 2039-2040 2040-2041 2041-2042 2042-2043 2043-2044 2044-2045 2045-2046 2046-2047 2047-2048
Coconut oil


Production (MT)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2018-2019 2019-2020 2020-2021 2021-2022 2022-2023 2023-2024 2024-2025 2025-2026 2026-2027 2027-2028 2028-2029 2029-2030 2030-2031 2031-2032 2032-2033 2033-2034 2034-2035 2035-2036 2036-2037 2037-2038 2038-2039 2039-2040 2040-2041 2041-2042 2042-2043 2043-2044 2044-2045 2045-2046 2046-2047 2047-2048
Cottonseed oil





***Source:** Authors' estimation based on data retrieved from MoA&FW*

Figure 4.16: National Forecasted Individual Secondary Oils Production

4.4 Edible Oils Demand-Supply Gap Analysis by 2030 and 2047

Recognizing a fundamental shortcoming in traditional methods that "applying a fixed norm of gross output" for the oil recovery rate, this analysis adopts a more nuanced approach to estimate India's future edible oil supply. Prior studies often rely on a single standardized extraction rate (i.e., a fixed norm of 28% of gross output for oil recovery rate from oilseeds), which fails to account for the significant variability inherent across different oilseed varieties. The approach employed a dual strategy, utilizing both a range of oil-to-oilseed conversion factors and incorporating net availability data from the Solvent Extractors Association (SEA). This data encompasses seed retention for sowing purposes, direct consumption, export levels, and other pertinent factors. Furthermore, the average % share of net availability for oil extraction over the last 3, 5, and 10 years was applied to account for potential year-on-year fluctuations. This multi-step approach strengthens the comprehensiveness of projections (presented in Table 4.9 in the BAU), which estimate the national-level edible oil supply to reach 16 MT by 2030 and 26.7 MT by 2047 from 13.3 MT in 2021-22. However, it is important to acknowledge that unforeseen circumstances or advancements in extraction technology could influence future oil recovery rates.

Table 4.9: Projected Edible Oils Supply at the National Level by 2030-31 and 2047-48

Items	Projected Edible Oils Supply (MT)		
	2021-22	2030-31	2047-48
Groundnut	1.40	1.60	2.20
Soybean	2.60	2.60	2.70
Rapeseed & Mustard	4.60	5.70	8.30
Sunflower	0.10	0.05	0.01
Castor	0.80	0.90	1.20
Niger seed	0.007	0.004	0.001
Safflower	0.02	0.02	0.03
Sesame	0.10	0.10	0.10
Linseed	0.10	0.00	0.0
Edible Oil from Primary Sources	9.70	11.1	14.6
Edible Oil from Secondary Sources	3.60	4.96	12.14
Total Edible Oil	13.3	16.0	26.7

Source: *Authors' estimation*

The analysis reveals a concerning gap between India's current edible oil demand and supply. The existing shortfall stands at a significant 14.4 MT, with domestic production (i.e., 13.3 MT) supplying less than half the national requirement (i.e., 27.7 MT). Projection based on the Household Approach scenario, this gap persists, albeit at decreasing levels, reaching an estimated 14.1 MT by 2030 and 5.9 MT by 2047 (Table 4.10). To bridge this critical gap domestic edible oil production needs to increase by a factor of 2.3 times and 2.5 times by 2030 and 2047, respectively, compared to current levels.

The Normative Approach scenario, grounded in the recommended intake levels established by ICMR-NIN, presents a contrasting outlook (Table 4.10). Under this scenario, India is projected to achieve a surplus in edible oil supply, reaching 0.13 MT by 2030 and 9.35 MT by 2047. This significant surplus stands in stark contrast to the existing substantial gap. The divergence highlights the potential impact of promoting healthy consumption habits in mitigating the edible oil demand-supply challenge. Policy interventions that encourage the adoption of ICMR-NIN's recommended intake levels, coupled with strategies to boost domestic edible oil production, can create a more sustainable and secure future for India's edible oil sector.

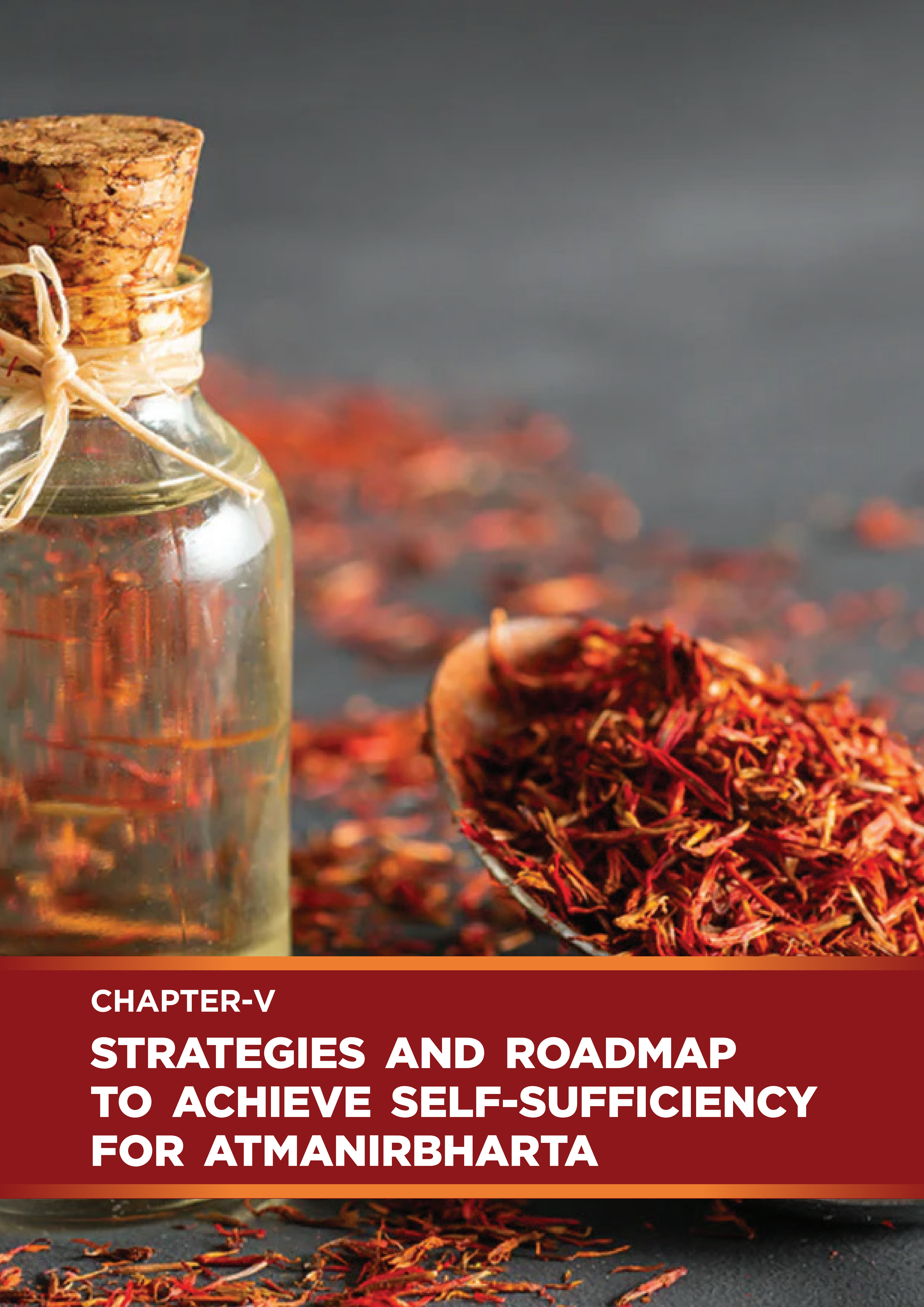
The Behaviouristic Approach presents a more concerning outlook, suggesting a potential widening of the edible oil demand-supply gap (Table 4.10). Addressing this substantial imbalance necessitates a significant and sustained increase in domestic edible oil production. Under scenario I, the gap is projected to reach 22.3 MT by 2030 and 15.2 MT by 2047, albeit at a decreasing rate. To achieve this, oilseed output would need to grow by a factor of 2.9 times and 3.2 times by 2030 and 2047, respectively, compared to current levels. Under scenario II, the gap is projected to reach a staggering 29.5 MT by 2030 and further escalate to 40 MT by 2047. To achieve equilibrium, oilseed output would need to be amplified by a factor of 3.4 times and a significant 5.0 times by 2030 and 2047, respectively, compared to current levels.

Table 4.10: Projected Edible Oils Demand-Supply Gap at National Level by 2030 and 2047

Year	Household Approach			Normative Approach			Behaviouristic Approach (Scenario-I)			Behaviouristic Approach (Scenario-II)		
	Supply (MT)	Demand (MT)	GAP (MT)	Supply (MT)	Demand (MT)	GAP (MT)	Supply (MT)	Demand (MT)	GAP (MT)	Supply (MT)	Demand (MT)	GAP (MT)
2030	16.0	30.1	-14.1	16.0	15.87	+0.13	16.0	38.3	-22.3	16.0	45.5	-29.5
2047	26.7	32.6	-5.9	26.7	17.35	+9.35	26.7	41.9	-15.2	26.7	66.8	-40.0

***Source:** Authors' estimation*

The concerning projections presented here underscore the critical need for robust policy interventions that address both sides of the edible oil equation: supply and demand. A multi-pronged approach is essential for India to achieve long-term edible oil security and mitigate the challenges facing this vital sector. Strategies focused on yield improvement, enhanced oilseed processing efficiency, area expansion for oilseed crops, potential diversification into new oilseed varieties, and the adaptation of advanced technologies can significantly reinforce domestic production. In parallel, promoting healthy consumption practices aligned with the ICMR-NIN recommendations can help to manage demand-side pressures. By implementing a comprehensive strategy that tackles both production and consumption, India can work towards bridging the edible oil gap and achieving self-sufficiency in this vital sector.



CHAPTER-V

STRATEGIES AND ROADMAP TO ACHIEVE SELF-SUFFICIENCY FOR ATMANIRBHARTA

STRATEGIES AND ROADMAP TO ACHIEVE SELF-SUFFICIENCY FOR ATMANIRBHARTA

Achieving self-sufficiency (*Atmanirbharta*) in edible oils presents a critical national objective for India. However, this goal necessitates a comprehensive strategy that tackles many challenges across the entire edible oil value chain. A significant challenge lies in the rain-fed production system, as 76% of the oilseed area is rain-fed, contributing to roughly 80% of total production. These rainfed areas are particularly vulnerable to environmental challenges such as aberrant weather patterns. Compounding this challenge is the limited expansion of irrigation coverage, which has only marginally increased by 4% over the past decade (23% to 27%). Socio-economic factors amplify the demand for edible oils, including population growth and rising living standards. To overcome these obstacles and achieve self-sufficiency, a multi-pronged approach is required. This approach must encompass strategies to enhance edible oil production, optimize yields, improve processing efficiency, and establish robust distribution networks.

Figure 5.1 presents an inclusive strategy for accelerating growth and achieving self-sufficiency (*Atmanirbharta*) in the Indian edible oil sector. This strategy is structured across three key pillars: (i) Crop Retention and Diversification, (ii) Horizontal Expansion, and (iii) Vertical Expansion. By implementing this multifaceted approach, India can unlock its full potential for domestic production and secure its edible oil future.

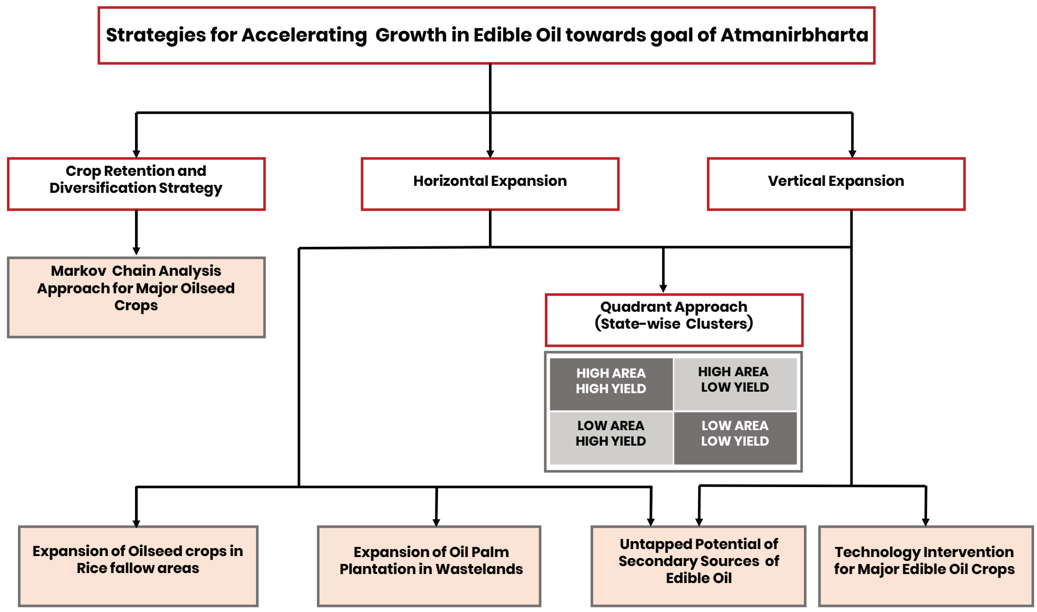


Figure 5.1 Strategies devised for accelerating growth in edible oil

The first pillar of the *Atmanirbharta* strategy emphasizes **Crop Retention and Diversification.** This strategy leverages the **Markov Chain Analysis Approach**, a statistical method that predicts future states based on current trends. By employing this tool, stakeholders can identify optimal strategies for retaining existing oilseed farmers while strategically diversifying the types of crops cultivated. This diversification strengthens resilience against market volatility and environmental disruptions, fostering long-term stability and sustainability within the edible oil sector.

The second and third pillars of the *Atmanirbharta* strategy focus on Horizontal and Vertical Expansion. The second pillar, Horizontal Expansion Strategy, aims to increase strategically the total area dedicated to cultivating edible oil crops. This strategy aims to bring more land under cultivation for specific oilseeds. Potential avenues for achieving this include reclaiming rice fallow lands and highly suitable wastelands[6] for transformation through agroforestry, as well as promoting crop retention and diversification in regions that currently focus on other agricultural crops. The third pillar, Vertical Expansion Strategy, focuses on enhancing the yield of existing oilseed cultivation areas. This can be achieved through improved farming practices, better-quality seeds, and the adoption of advanced technologies.

Horizontal and Vertical Expansion Strategies derived from the **State-wise Quadrant Approach** are shown in Table 5.1. This data-driven approach involves developing state-level crop clusters using four quadrants **[i.e., (i) High Area-High Yield (HA-HY), (ii) High Area-Low Yield (HA-LY), (iii) Low Area-High Yield (LA-HY), and (iv) Low Area-Low Yield (LA-LY)]** for the oilseed crops cultivated in India. It used each state's cultivated area and yield performance data from 2017-18 to 2021-22 for the specific oilseed crops. High Area is defined as above the national average area cultivated for a specific oilseed crop, while Low Area is below the national average. **High Yield** is determined by exceeding the national average yield for that crop, whereas Low Yield falls below the national average yield.

HA-HY clusters, having high area and high yields, should prioritize vertical expansion strategies focused on maximizing yield against global leaders in oilseed production can provide valuable insights for further improvement. Similarly, **HA-LY clusters,** characterized by high area but lower yields, necessitate vertical expansion initiatives to enhance yield. Here, benchmarking against India's best performers states can be instrumental. Conversely, **LA-HY clusters,** with lower cultivation area but pockets of high yield, present opportunities for horizontal expansion to increase their oilseed footprint. These regions can also benefit from benchmarking against national leaders to identify areas for further improvement in cultivation practices. Finally, **LA-LY clusters,** with low cultivation area and low yields, require a comprehensive approach combining both horizontal and vertical expansion strategies. Benchmarking against the country's top performers will be crucial for these clusters to identify areas for improvement.

6. To assess the agroforestry suitability regimes in wastelands across the country, multi-thematic datasets on wastelands, Land Use Land Cover, waterbodies, soil organic carbon & slope at 1:50,000 scale identified, and appropriate weightage applied, to carry out a national level overlay analysis (NITI Aayog 2024).

Table 5.1: Quadrant strategy for horizontal and vertical expansion

Edible Oil Crop		Yield	
		High	**Low**
Area	**High**	**High Area** (>National average area); **and High Yield** (> National average yield) **(Benchmark: Global Best Performer(s))** **(Strategy: Vertical Expansion)**	**High Area** (>National average area); **and Low Yield** (< National average yield) **(Benchmark: Country Best Performer(s))** **(Strategy: Vertical Expansion)**
Area	**Low**	**Low Area** (<National average area); **and High Yield** (> National average yield) **(Benchmark: Country Best Performer(s))** **(Strategy: Horizontal Expansion)**	**Low Area** (<National average area); **and Low Yield** (< National average yield) **(Benchmark: Country Best Performer(s))** **(Strategy: Horizontal + Vertical Expansion)**

In addition, **Horizontal Expansion Strategy** includes the Rice Fallow **Area Expansion Approach,** significant potential lies in utilizing rice fallow lands for oilseed production during the non-rice cropping season. By promoting suitable crop rotations and effective water management practices and implementing targeted incentives and knowledge transfer programs, farmers can be encouraged to cultivate favourable oilseed crops during these fallow periods, effectively increasing overall land utilization and production capacity. These combined efforts will lead to a geographically expansive and diversified edible oil production landscape, contributing significantly to India's self-sufficiency (*Atmanirbharta*) goals.

Complementing the state-wise quadrant strategy, a geographically targeted **cluster-based approach** holds significant promise for accelerating edible oil sector growth. This quadrant analysis will allow for customized interventions and help to optimize the resource allocation by focusing on each cluster separately. In the HA-HY cluster, crop retention programs incentivize farmers to maintain production, ensuring a stable domestic supply. Conversely, in quadrants with lower existing oilseed production (particularly LA-LY cluster), strategic diversification initiatives can be introduced. These initiatives involve cultivating higher yielding oilseed varieties, fostering a more geographically diversified production landscape. This targeted strategy, coupled with initiatives like the expansion of fallow land cultivation, improved farming practices, ensuring seed quality and traceability, market linkages with effective storage strategies, value addition through processing and refining techniques, and advanced production technologies adoption, holds significant promise for maximizing the impact of the *Atmanirbharta* strategy and fostering a resilient domestic edible oil production system.

5.1. Crop Diversification and Retention in Major Oilseed States: Markov Chain Model

This section highlights the structural changes observed in cropping patterns across key edible oilseed producing states in India. To guide the development of effective strategies for oilseed crop diversification and retention, a Transitional Probability Matrix (TPM) analysis based on Markov Chain Model is used. This statistical method sheds light on the likelihood of farmers shifting cultivation patterns from one oilseed crop to another over a significant period. Time series data of the cultivation area dedicated to various crops were collected from the Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers' Welfare and scrutinized for the period spanning from 2000-01 to 2021-22. The analysis was conducted for the Kharif and Rabi seasons separately.

The analysis focuses on nine key oilseed-producing states namely Andhra Pradesh, Gujarat, Haryana, Rajasthan, Madhya Pradesh, Uttar Pradesh, Karnataka, Tamil Nadu, and Maharashtra which collectively contribute over 90% of India's total oilseed area and production. By examining historical trends in crop transitions within these states, the TPM provides valuable insights into crop substitution behavior among farmers. By understanding the probabilities of crop replacement, can make more informed decisions about how to manage their land for optimal crop yield and sustainability. Following the application of the TPM analysis on nine major oilseed-producing states in India, the section below discusses the summary results, with a focus on the retention rates of major oilseeds cultivated in these states.

5.2 Crop Retention Rates

The retention rates of major oilseed crops in Indian states, along with the replacing crops, are given in Table 5.2. Among the major oilseed crops, Groundnut cultivation exhibits medium retention rates in various states (i.e., Gujarat, Andhra Pradesh), ranging from 43% to 64% in Kharif season as well as in Tamil Nadu and Karnataka across both seasons. Conversely, low retention rates are observed in Gujarat (Rabi), Rajasthan (Kharif), Madhya Pradesh (Kharif) and Maharashtra. In Soybean, Madhya Pradesh and Rajasthan exhibit good retention rates (72%), indicating a preference for continued Soybean cultivation in these regions. In contrast, Gujarat and Karnataka show notably lower retention rates for Soybean cultivation, suggesting a higher likelihood of farmers switching to other crops. Conversely, Maharashtra falls in between with a retention rate of 38%, implying a moderate inclination towards continuing Soybean cultivation.

Rapeseed & Mustard cultivation also shows varying retention rates across states, with Uttar Pradesh demonstrating exceptionally high retention at 92%, indicating a strong preference for continued cultivation. Similarly, Haryana (62%) and Rajasthan (50%) also exhibit medium retention rates. In contrast, Gujarat shows a moderate retention rate of 40%, suggesting a somewhat lower inclination towards continuing Rapeseed & Mustard cultivation. Cotton exhibits medium retention rates in regions such as Karnataka, Andhra Pradesh, Haryana and Maharashtra. Sunflower cultivation demonstrates retention rate of

64% in Andhra Pradesh, while it maintains moderate retention levels in Maharashtra during the Rabi season and in Karnataka during the Kharif season. However, it experiences zero retention in Maharashtra during the Kharif season, as well as in Haryana and Karnataka during the Rabi season.

Safflower cultivation exhibits a retention rate of 72% in Maharashtra, showcasing the crop's significant popularity and economic viability in the region. In contrast, Karnataka experiences the lowest retention rate for safflower. In Gujarat (Kharif), Sesamum retains only 9% of its area, transitioning primarily to Cotton, Jowar, and Maize. Similarly, Uttar Pradesh and Andhra Pradesh (Kharif) both see a low retention rate of 21%.

Castor retention rates vary from 46% to 60%, suggesting a more stable cultivation pattern and indicating that a significant portion of Castor cultivation remains consistent between seasons. Linseed shows 27% in Uttar Pradesh, with farmers predominantly shifting to Lentil cultivation. Sunflower retains just 38% of its area in Maharashtra (Rabi), 64% in Andhra Pradesh (Rabi) and 50% in Karnataka (Kharif).

Oilseed crops experiencing 0% retention rates across various states include Soybean in Gujarat (Kharif) and Karnataka (Kharif), Mustard and Linseed in Madhya Pradesh (Rabi), Sunflower in Maharashtra (Kharif), Haryana (Rabi), and Karnataka (Rabi), Safflower in Karnataka (Rabi), and Sesamum in Tamil Nadu (Kharif). Additionally, Groundnut shows 0% retention in Gujarat (Rabi), Madhya Pradesh (Kharif), Maharashtra, and Andhra Pradesh (Rabi). To increase retention areas for these oilseeds, targeted interventions could include providing financial incentives, enhancing agricultural extension services to educate farmers on best practices, improving access to quality seeds, and investing in irrigation infrastructure to mitigate water stress. Additionally, improving market linkages to ensure profitable returns is crucial. Crop diversification can be done in these regions after identifying the crops that are replacing oilseeds.

Table 5.2: Retention Rate of Major Oilseed Crops by Key States

State	Season	Replaced Oilseed Crops	Retention Rate	Replacing Crops
Gujarat	Kharif	Castor	46%	Rice, Soybean
		Groundnut	64%	Rice, Maize, Arhar
		Soybean	0%	Castor
		Sesamum	9%	Cotton, Jowar, Maize
	Rabi	Groundnut	0%	Wheat
		Rapeseed & Mustard	40%	Moong, Wheat, Groundnut
Rajasthan	Kharif	Soybean	72%	Rice, Groundnut
		Groundnut	14%	Moong
		Castor	60%	Groundnut
	Rabi	Rapeseed & Mustard	50%	Wheat, Barley

State	Season	Replaced Oilseed Crops	Retention Rate	Replacing Crops
Madhya Pradesh	Kharif	Soybean	72%	Rice, Arhar, Sesamum
		Groundnut	0%	Soybean
		Sesamum	6%	Urad
	Rabi	Rapeseed & Mustard	0%	Wheat, Gram
		Linseed	0%	Lentil
Maharashtra	Kharif	Soybean	38%	Maize, Cotton
		Groundnut	0%	Moong, Urad
		Cotton	27%	Rice, Soybean
		Sunflower	0%	Maize
	Rabi	Safflower	72%	Sunflower
		Sunflower	38%	Jowar
		Groundnut	0%	Wheat
Haryana	Kharif	Cotton	47%	Rice, Bajra
	Rabi	Rapeseed & Mustard	62%	Wheat
		Sunflower	0%	Wheat
Andhra Pradesh	Kharif	Groundnut	52%	Arhar, Castor, Cotton
		Castor	51%	Groundnuts, Rice
		Cotton	49%	Arhar, Sesamum
		Sesamum (Til)	21%	Arhar, Castor
	Rabi	Groundnut	0%	Jowar
		Sunflower	64%	Rice, Maize, Green Gram, Groundnuts
Uttar Pradesh	Kharif	Sesamum	21%	Bajra, Black gram
	Rabi	Rapeseed & Mustard	92%	Gram, Barlet
		Linseed	27%	Lentil
Karnataka	Kharif	Groundnuts	43%	Bajra, Sunflower
		Sunflower	50%	Rice, Groundnuts
		Cotton	56%	Soybeans, Green Gram
		Soybean	0%	Arhar
	Rabi	Groundnuts	57%	Wheat, Rice, Safflower
		Sunflower	0%	Gram
		Safflower	0%	Sunflower
Tamil Nadu	Kharif	Groundnuts	52%	Rice, Sesamum
		Sesamum	0%	Rice, Jowar
	Rabi	Groundnuts	63%	Rice

Source: Authors' computation

5.2.1 Enhancing India's Edible Oil Production Through Strategic Retention of Oilseed Crops

Strategic retention of oilseed crops presents a promising avenue to significantly enhance India's edible oil production capacity and reduce dependence on imports. This approach has the potential to significantly enhance production capacity in nine focus states. By focusing solely on areas potentially lost to cereal cultivation, these states could see a substantial increase of 20%, translating to an additional 7.36 MT of oilseeds production (Table 5.3). This significant rise in production would translate to a notable reduction of 14.2% (or 2.1 MT) in India's edible oil import dependence, effectively narrowing the demand-supply gap estimated at 14.4 MT for the base year 2021-22. These findings underscore the strategic importance of retaining oilseed cultivation and its potential to contribute significantly to achieving self-sufficiency in edible oils. Further research may help to explore effective mechanisms for incentivizing farmers to retain oilseed cultivation in these critical states.

Table 5.3: Oilseeds: Potential Production (MT) by Strategically Retention of Oilseed Crops and Gap with Current Production

Oilseeds	Actual Production (2021-22) (MT)	Potential Production through Strategical Retention of Oilseed Crops (MT)	% Increase in Production through Strategical Retention of Oilseed Crops	Gap between Potential and Actual Production by Strategical Retention of Oilseed Crops (MT)
Groundnut	10.14	12.05	47	4.78
Soybean	12.99	14.57	44	5.67
Rapeseed & Mustard	11.96	15.7	37	4.42
Sunflower	0.25	0.3	40	0.1
Sesame	0.79	0.87	42	0.33
Total	36.12	43.49	20	7.36

Source: *Authors estimations*

5.3 Quadrant Strategy for Diversification and Accelerated Growth

This section explores the findings of a state-wise Quadrant Analysis conducted for each major oil crop cultivated in India. This data-driven approach categorizes states into four clusters (HA-HY, HA-LY, LA-HY and LA-LY) based on their current performance in both horizontal (area) and vertical (yield) dimensions. This framework allows for the creation of targeted interventions tailored to each state cluster, ultimately guiding a future roadmap toward self-sufficiency in edible oils. By leveraging a combination of horizontal and vertical expansion strategies within these clusters, the analysis facilitates targeted growth.

Table 5.4 below provides valuable insights into the national average yield (t/ha) and cultivated area (Mha) for these crops from 2017-18 to 2022-23. Castor emerges with the highest yield at 1.81 t/ha, closely trailed by groundnut at 1.77 t/ha. Mustard also demonstrates a substantial yield of 1.45 t/ha. Soybean, sunflower, and safflower yield moderately, ranging from 1.03 to 0.70 t/ha. Conversely, sesamum, linseed, and niger seed exhibit comparatively lower yields. Regarding total cultivated area, soybean holds the largest share with 11.74 Mha, succeeded by mustard with 6.73 Mha among oilseeds. Groundnut and castor also command noteworthy cultivated areas. Among the secondary oil crops, rice and cotton hold substantial acreage with 45.07 Mha and 12.86 Mha followed by coconut (2.16 Mha).

Table 5.4: Area and Yield of Major Edible Oil Crops in India (2017-2022)

Edible Oil Crops	National Yield (t/ha)	Total Cultivated Area (Mha)
Soybean	1.03	11.74
Mustard	1.45	6.73
Groundnut	1.77	5.23
Sesamum	0.46	1.59
Castor	1.81	0.87
Sunflower	0.88	0.25
Linseed	0.61	0.21
Niger Seed	0.31	0.15
Safflower	0.70	0.06
Coconut	9665 (in nuts/ha)	2.16
Cotton	0.52	12.86
Rice	2.77	45.07

Source: *Authors' computation*

To further optimize yield, high-performing Indian states identified should engage in comparative benchmarking with the top global performers in each oilseed category. Table 5.5 provides valuable insights into the existing yield gap between India's highest-yielding state and the global leader for each crop. By closing this gap through implementing targeted strategies based on learning's from global leaders, these high-performing Indian states can significantly increase their output and contribute even more effectively to the nation's edible oil production goals.

Notably, global producers achieve higher yields than Indian oilseed crops primarily due to the use of genetically modified (GM) and herbicide-tolerant varieties.

Table 5.5: Yield difference between the highest yielding Indian state and highest among world producer

Edible Oil Crops	High area-high yield state of India	Highest Global Producer Country in the World (2017-2022)	Yield Difference
Soybean	Maharashtra (1.26 t/ ha)	Brazil (3.2 t/ha)	-1.94
Rapeseed	Rajasthan (1.58 t/ ha)	Canada (2.17 t/ha)	-0.59
Groundnut	Gujarat (2.20 t/ ha)	China (3.84 t/ha)	-1.64
Sesamum	West Bengal (0.82 t/ ha)	Sudan (0.28 t/ha)	0.54
Castor	Gujarat (2.0 t/ ha)	India (1.76 t/ha)	-
Sunflower	Odisha (1.27 t/ ha)	Ukraine (2.25 t/ha)	-0.98
Linseed	Madhya Pradesh (0.67 t/ ha)	Russia (0.86 kg/ha)	-0.19
Niger Seed	Odisha (0.37 t/ ha)	NA	NA
Safflower	Karnataka (0.82 kg/ ha)	Kazakhstan (0.71 t/ha)	0.11
Cotton	Gujarat (0.55 t/ ha)	China (5.52 t/ha)	-4.97
Rice	West Bengal (2.94 t/ ha)	China (7.03 t/ha)	-4.09
Coconut	Tamil Nadu (12210 nuts/ ha)	Indonesia (NA)	NA

Figures *in parenthesis represents yield;*

Source: Authors' computation from MoAF&W

A significant opportunity exists to enhance productivity in India's edible oil sector, as evidenced by the yield difference between Indian states and global leaders. Crops like soybean, rapeseed, groundnut, sunflower, linseed, cotton, and rice all demonstrate lower yields in India compared to top global producers. For cotton, Gujarat's yield is significantly lower than China's, with a 4.97 t/ha difference. West Bengal lags behind China in rice production by 4.09 t/ha. Maharashtra's soybean yield is 1.94 t/ha less than Brazil's. Gujarat also trails China in groundnut yield by 1.64 t/ha. Odisha's sunflower yield is nearly 1.0 t/ha less than Ukraine's. Rajasthan's rapeseed yield is 0.59 t/ha lowers than Canada's, and Madhya Pradesh's linseed yield is slightly below Russia's by 0.19 t/ha. These differences indicate significant potential for yield improvement in Indian agriculture to match global standards.

However, India exhibits strength in castor, niger seed, sesamum, coconut and safflower, currently holding the position of the highest yield producer globally for these crops. By focusing on interventions by the quadrant analysis and benchmarking exercises, India can strategically address these yield differences.

5.3.1 State-wise Quadrant Strategy: Soybean

Quadrant analysis reveals Maharashtra as the sole state within India's HA-HY cluster for soybean cultivation (Table 5.6). This signifies Maharashtra's well-established acreage and yields for this crop. To maximize productivity in this region, a vertical expansion strategy should be prioritized. Benchmarking against global leader(s) like the United States, Brazil, and Argentina, who boast superior soybean yields, can be highly beneficial. These countries have achieved significant advancements in seed technology, precision agriculture, irrigation management, and integrated pest management systems apart from using GM-modified varieties. By adopting learning from these leading producers, Maharashtra can identify areas for improvement and implement targeted strategies to further optimize soybean cultivation practices within the state.

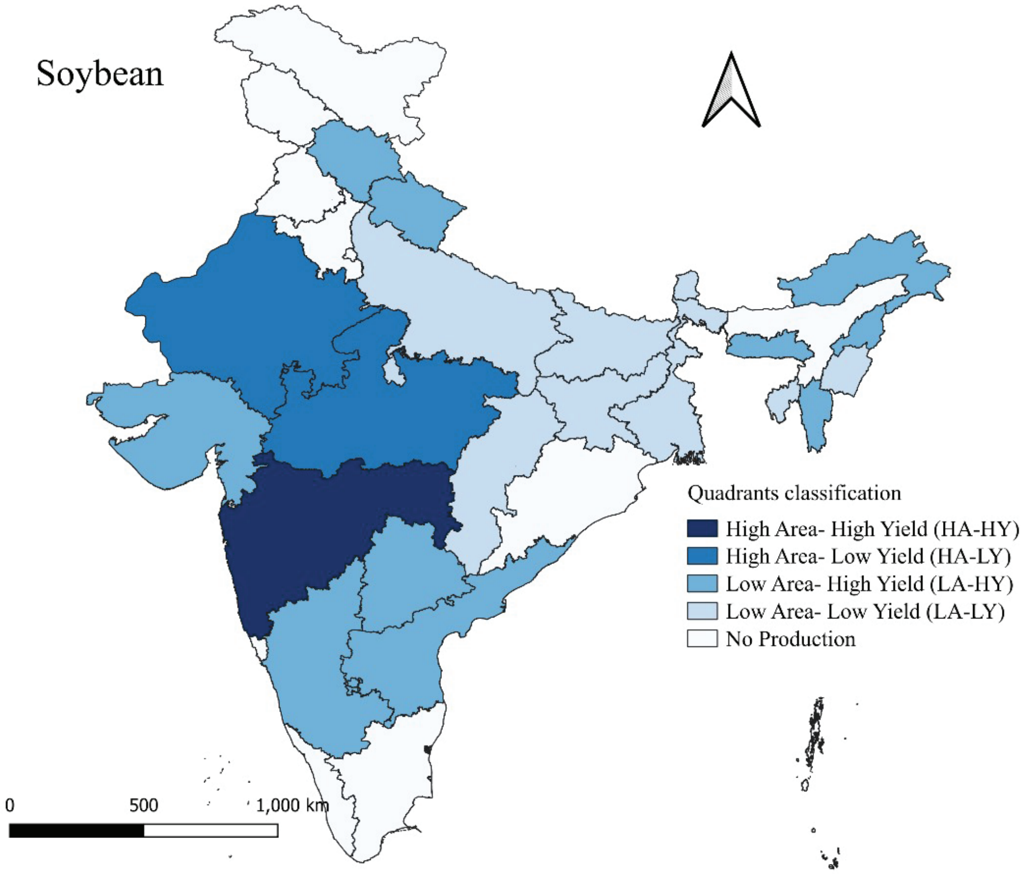
Table 5.6: Area and Yield of Soybean in Indian States

Soybean		Yield (National Average: 1.03 t/ha)	
		High	**Low**
Area (National Average: 0. 55 Mha)	**High**	Maharashtra	Madhya Pradesh, Rajasthan
	Low	Karnataka, Telangana, Gujarat, Nagaland, Uttarakhand, Arunachal Pradesh, Meghalaya, Andhra Pradesh, Mizoram, Himachal Pradesh	West Bengal, Tripura, Sikkim, Jharkhand, Manipur, Bihar, Chhattisgarh, Uttar Pradesh

Source: *Authors' computation*

Further, the quadrant analysis exposes opportunities for targeted interventions across other clusters. States like Madhya Pradesh and Rajasthan, falling within HA-LY cluster, necessitate vertical expansion initiative to enhance their soybean yield. Benchmarking against India's best performer(s), these states can identify and adopt best practices in areas like seed technology, precision agriculture, and pest management. Conversely, states categorized as LA-HY cluster (i.e., Karnataka, Telangana, Gujarat, Nagaland, Uttarakhand, Arunachal Pradesh, Meghalaya, Andhra Pradesh, Mizoram, Himachal Pradesh) present opportunities for horizontal expansion to increase their soybean cultivation area. These states can also benefit from benchmarking against the national leader(s) to identify areas for further improvement. Finally, states in the LA-LY cluster, such as West Bengal, Uttar Pradesh, Sikkim, Jharkhand, Manipur, Bihar and Chhattisgarh require a comprehensive strategy combining both horizontal and vertical expansion approaches. Benchmarking against success of the country's best performer(s) will be crucial for these states to identify areas for improvement and implement effective strategies to boost both acreage and productivity.

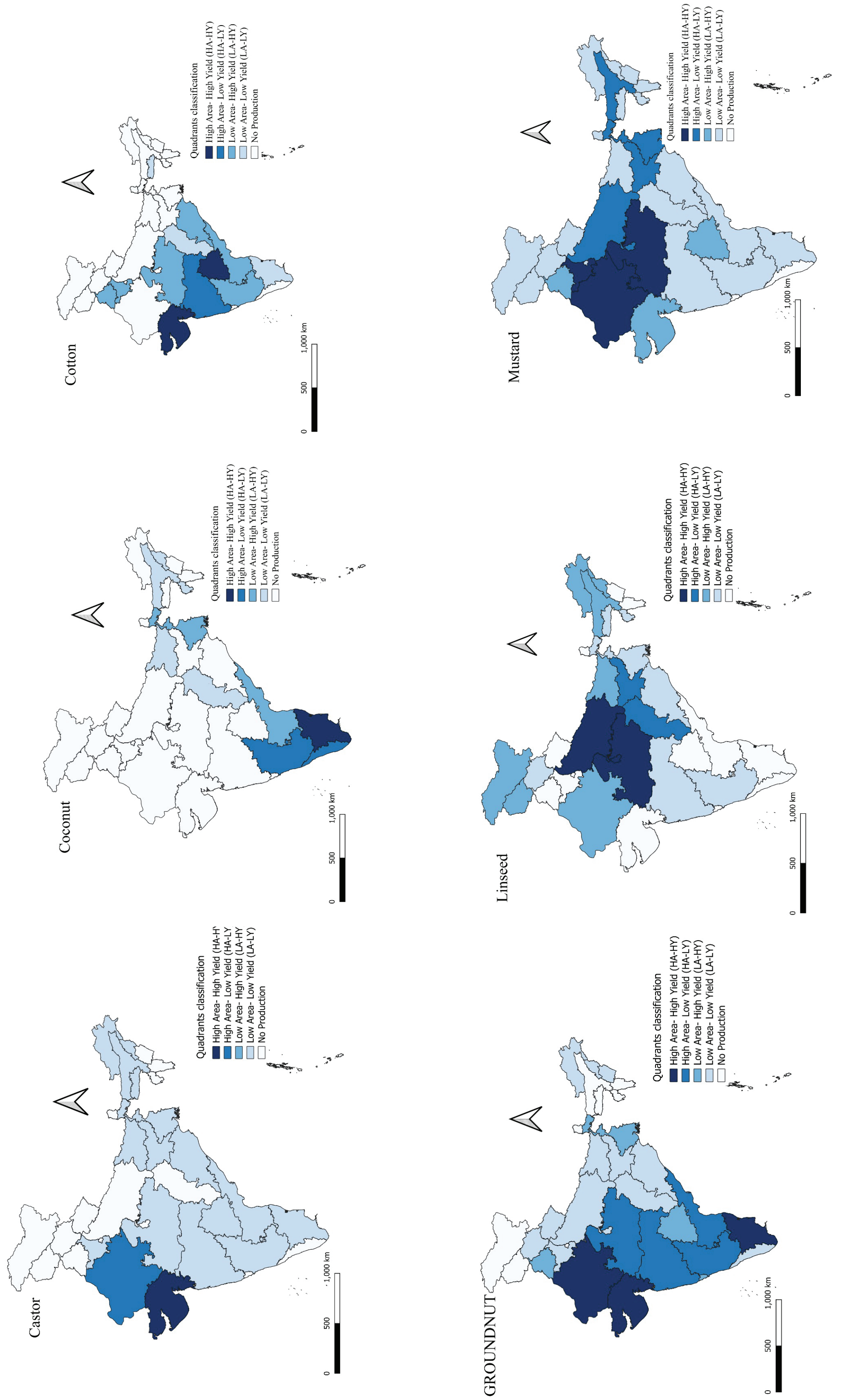
To visualize the geographical distribution of soybean cultivation potential across India, state-wise cluster map derived from the quadrant analysis is provided in Map 5.1. This map offers valuable insights into the current performance of various states in terms of both horizontal (area) and vertical (yield) dimensions of soybean cultivation.

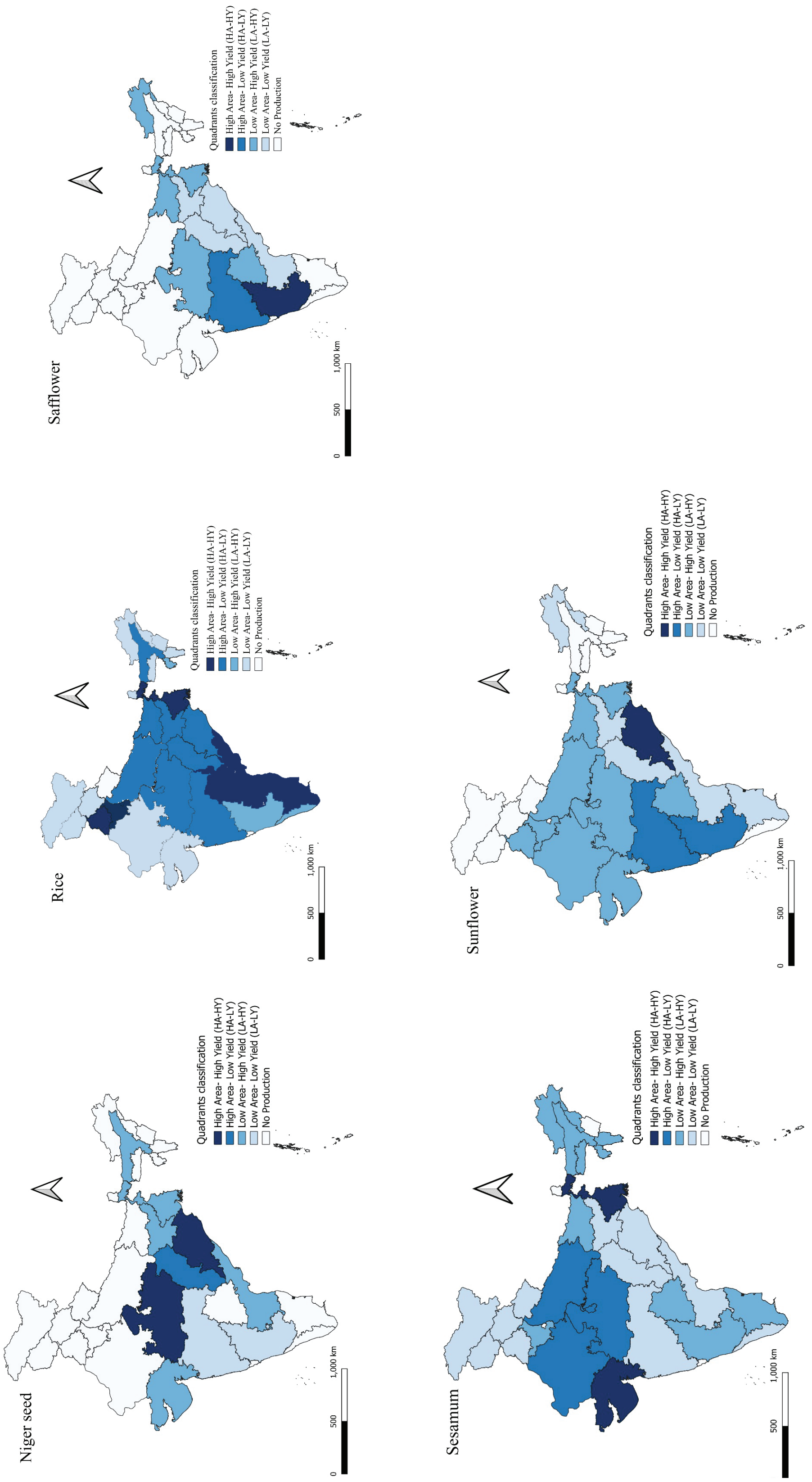


Map 5.1: Soybean: State-wise Cluster

Building upon the soybean example, state-wise cluster maps (Map 5.2)[7] are provided for other edible oil crops. By tailoring policy measures to address the unique challenges and opportunities within each cluster, this cluster-based specific approach has the potential to significantly enhance the effectiveness of efforts aimed at promoting production and yield improvements across the edible oil sector. It is important to note that palm oil is not included in the quadrant analysis due to limitations in the availability of consistent state-wise yield data. However, given its significant contribution of about 59% to India's total edible oil imports, palm oil is considered separate section. A dedicated section later in this chapter will address strategies for enhancing palm oil production and reducing import dependence.

7. Detailed Quadrant strategy tables are provided in the Annexure-V


Cotton
Quadrants classification
High Area- High Yield (HA-HY)
High Area- Low Yield (HA-LY)
Low Area- High Yield (LA-HY)
Low Area- Low Yield (LA-LY)
No Production
0 500 1,000 km
Mustard
Quadrants classification
High Area- High Yield (HA-HY)
High Area- Low Yield (HA-LY)
Low Area- High Yield (LA-HY)
Low Area- Low Yield (LA-LY)
No Production
0 500 1,000 km
Coconut
Quadrants classification
High Area- High Yield (HA-HY)
High Area- Low Yield (HA-LY)
Low Area- High Yield (LA-HY)
Low Area- Low Yield (LA-LY)
No Production
0 500 1,000 km
Linseed
Quadrants classification
High Area- High Yield (HA-HY)
High Area- Low Yield (HA-LY)
Low Area- High Yield (LA-HY)
Low Area- Low Yield (LA-LY)
No Production
0 500 1,000 km
Castor
Quadrants classification
High Area- High Yield (HA-H
High Area- Low Yield (HA-LY
Low Area- High Yield (LA-HY
Low Area- Low Yield (LA-LY)
No Production
0 500 1,000 km
GROUNDNUT
Quadrants classification
High Area- High Yield (HA-HY)
High Area- Low Yield (HA-LY)
Low Area- High Yield (LA-HY)
Low Area- Low Yield (LA-LY)
No Production
0 500 1,000 km



Map 5.2. State-wise Clusters for Primary and Secondary Edible Oil Crops

Following establishing state clusters through the quadrant analysis, Table 5.7 presents a comprehensive strategy for horizontal and vertical expansion across various oil crops cultivated in India. Table 5.7 serves as an actionable roadmap, effectively categorizing states for each oil crop based on their specific requirements for horizontal and vertical expansion strategies. (Annexure-V).

Table 5.7: Tailored Interventions for State-Specific Growth: A Multi-Crop Strategy Matrix

Edible Oil Crops	Horizontal Expansion	Vertical Expansion	Horizontal & Vertical Expansion
Soybean	Karnataka, Telangana, Gujarat, Nagaland, Uttarakhand, Arunachal Pradesh, Meghalaya, Andhra Pradesh, Mizoram, Himachal Pradesh	Madhya Pradesh, Rajasthan	West Bengal, Tripura, Sikkim, Jharkhand, Manipur, Bihar, Chhattisgarh, Uttar Pradesh
Mustard and Rapeseed	Gujarat, Punjab, Telangana	Uttar Pradesh, West Bengal, Jharkhand, Assam	Bihar, Jammu & Kashmir, Chhattisgarh, Manipur, Arunachal Pradesh, Nagaland, Uttarakhand., Maharashtra, Meghalaya, Odisha, Himachal Pradesh, Tripura, Delhi, Sikkim, Andhra Pradesh, Karnataka, Mizoram, Tamil Nadu
Groundnut	Telangana, West Bengal, Punjab, Goa, Puducherry	Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra	Uttar Pradesh, Odisha, Chhattisgarh, Jharkhand, Haryana, Tripura, Manipur, Uttarakhand, Nagaland, Arunachal Pradesh, Bihar, Kerala, Himachal Pradesh
Sesamum	Tamil Nadu, Karnataka, Telangana, Assam, Tripura, Nagaland, Meghalaya, Arunachal Pradesh, Haryana, Bihar, Mizoram, Puducherry	Madhya Pradesh, Uttar Pradesh, Rajasthan	Andhra Pradesh, Maharashtra, Chhattisgarh, Odisha, Jharkhand, Jammu & Kashmir Punjab, Uttarakhand, Himachal Pradesh, Kerala, Dadra & Nagar Haveli
Castor	Nil	Rajasthan	Andhra Pradesh., Telangana, Maharashtra, Odisha, Tamil Nadu, Madhya Pradesh, Karnataka, Haryana, Assam, Nagaland, Arunachal Pradesh, Bihar, Jharkhand Meghalaya, West Bengal
Sunflower	Haryana, Telangana, Bihar, West Bengal, Punjab, Uttar Pradesh, Gujarat, Madhya Pradesh, Rajasthan	Karnataka, Maharashtra	Andhra Pradesh, Tamil Nadu, Nagaland, Arunachal Pradesh, Jharkhand, Chhattisgarh
Linseed	Bihar, Rajasthan, Nagaland, Assam, Jammu & Kashmir, Arunachal Pradesh	Jharkhand, Chhattisgarh	Odisha, Maharashtra, West Bengal, Karnataka, Himachal Pradesh, Meghalaya, Tripura

Edible Oil Crops	Horizontal Expansion	Vertical Expansion	Horizontal & Vertical Expansion
Niger Seed	Assam, Andhra Pradesh, Jharkhand, Gujarat, West Bengal	Chhattisgarh	Maharashtra, Karnataka
Safflower	Telangana, Madhya Pradesh, Arunachal Pradesh, West Bengal, Bihar	Maharashtra	Jharkhand, Andhra Pradesh, Odisha, Chhattisgarh
Cotton	Punjab, Kerala, Jammu and Kashmir, Odisha	Maharashtra, Telangana, Haryana, Karnataka, Madhya Pradesh	West Bengal, Tamil Nadu, Meghalaya, Chhattisgarh, Puducherry, Uttar Pradesh, Nagaland, Tripura, Mizoram, Assam
Rice	Chandigarh, Karnataka, Tripura, Puducherry, Delhi, Kerala	Uttar Pradesh, Bihar, Madhya Pradesh, Assam, Jharkhand, Odisha, Maharashtra, Chhattisgarh	Meghalaya, Andaman and Nicobar Islands, Rajasthan, Manipur, Gujarat, Dadra and Nagar haveli, Jammu and Kashmir, Himachal Pradesh, Sikkim, Arunachal Pradesh, Mizoram, Daman and Diu, Nagaland
Coconut	West Bengal, Andhra Pradesh	Kerala, Karnataka	Tripura, Bihar, Chhattisgarh, Nagaland, Assam, Gujarat, Maharashtra, Odisha

***Source:** Authors' computation on data from MoAF&W*

5.4 Rabi rice fallow areas: Horizontal expansion of primary oilseeds

Rice follows, lowland Kharif sown rice areas that remain uncropped during Rabi (winter), represent a significant potential for horizontal expansion in edible oilseed production. These fallows arise due to various factors like early monsoon withdrawal leading to soil moisture stress at planting time of winter crops, waterlogging, excessive moisture in November/December, lack of appropriate varieties of winter crops for late planting, and socio-economic problems (NAAS, 2013; Ali and Kumar, 2009). Strategic research focused on rice-fallow systems holds immense potential for maximizing total cultivated land (Kar & Kumar, 2009). However, establishing a second crop during the Rabi (winter) season presents challenges due to potential abiotic and biotic stresses encountered in the post-rainy season (Kumar et al., 2018). Among the states, Madhya Pradesh and Chhattisgarh have the highest combined area under rice fallow at 4.38 Mha (78.21%), followed by Bihar and Jharkhand with 2.2 Mha (36.85%). West Bengal, Odisha, and Maharashtra also have significant areas under rice fallow, while Assam, Uttar Pradesh, and Andhra Pradesh have comparatively smaller extents. The total rice fallow area across all states amounts to 11.65 M ha.

Since leveraging rice fallows for oilseed cultivation presents a significant opportunity to expand India's domestic edible oil production identifying potential crops suitable for oilseed cultivation in rice fallows is important. An overview of oilseed crops suitable for cultivation in rice fallow areas across various Indian states is provided in the Table 5.8. For instance, Madhya Pradesh and Chhattisgarh are well-suited for linseed, sesame, mustard, and toria, while Bihar and Jharkhand offer a broader range encompassing linseed, sunflower, safflower, toria, yellow surson, and mustard. West Bengal and Odisha also present a varied selection with groundnut, linseed, sunflower, safflower, rapeseed, mustard, and toria being suitable choices. Maharashtra suggests groundnut, linseed, sesame, sunflower, safflower, and mustard. Assam prioritizes toria and linseed, while Uttar Pradesh offers sunflower, linseed, rapeseed, mustard, and toria as viable choices. Lastly, Andhra Pradesh recommends groundnut, linseed, sesame, sunflower, safflower, mustard, and banarasi rai.

Table 5.8: Potential crops suitable for rice fallow states

States	Crops
MP + Chhattisgarh	Linseed, Sesame, Mustard & Toria
Bihar + Jharkhand	Linseed, Sunflower, Safflower, Toria, Yellow Surson & Mustard
West Bengal	Groundnut, Linseed, Sunflower, Safflower, Rapeseed, Mustard & Toria
Odisha	Groundnut, Linseed, Sesame, Sunflower, Safflower, Rapeseed, Mustard & Toria
Maharashtra	Groundnut, Linseed, Sesame, Sunflower, Safflower & Mustard
Assam	Toria, Linseed
Uttar Pradesh	Sunflower, Linseed, Rapeseed, Mustard & Toria
Andhra Pradesh	Groundnut, Linseed, Sesame, Sunflower, Safflower, Mustard & Banarasi Rai

Source:* *Author's compilation from research studies

Since rice fallows can accommodate millets, pulses, and oilseed crops, determining the optimal mix of these crops has become a pressing concern, especially with government intervention emphasizing the cultivation of all three. The aforementioned Table 5.8 highlights suitable oilseed options for specific regions. The total rice fallow area is further divided into three: one-third each for millets, pulses, and oilseeds. However, for an effective comparison of oilseed crops, their productivity must be evaluated.

Utilizing just one-third of the total rice fallow area across ten states for oilseed cultivation has the potential to significantly enhance domestic production. Estimates suggest a potential increase of up to 3.12 MT in oilseed output. This statistic underscores the immense potential of these currently fallow lands. By implementing efficient management practices, these areas can be transformed into significant contributors to India's overall agricultural output and play a crucial role in the nation's journey towards edible oil self-sufficiency.

Leveraging state-specific crop suitability, significant potential exists for enhancing oilseed production across various regions. In Madhya Pradesh and Chhattisgarh, cultivation of linseed, sesame, and mustard could increase total output to 0.85 MT (Table 5.9). Similarly, Bihar and Jharkhand hold the potential to reach 0.62 MT by introducing linseed, sunflower, safflower, and mustard. West Bengal and Odisha also present promising opportunities. With groundnut, linseed, sesame, sunflower, safflower, and mustard cultivation, West Bengal's production could rise to 0.68 MT, while Odisha's output could reach 0.32 MT. By strategically cultivating linseed and mustard in rice fallows, Assam's oilseed output could increase to 0.11 MT. Uttar Pradesh, with its suitability for linseed, sunflower, and mustard, has the potential to achieve a production boost of up to 0.40 MT. Andhra Pradesh can similarly leverage rice fallows for oilseed production, with groundnut, sesame, sunflower, safflower, and mustard identified as suitable options, potentially elevating the state's yield to 0.06 MT.

In ten focus states, this approach has the potential to increase edible oil production by an additional 1.03 MT, representing a significant 7.1% reduction in India's import reliance or demand-supply gap. This finding highlights the potential of rice fallows to significantly enhance India's overall production capacity and reduce dependence on imports. To ensure the economic viability and large-scale implementation of this strategy across the potential states, exploration of the economic feasibility of large-scale cultivation and identification of the optimal crop selection for different regions is critical.

Table 5.9: Potential oilseed production from utilized rice fallow areas in selected states

<table>
<tr><th rowspan="2">States</th><th rowspan="2">Area Under Rice Fallow (Rabi) (Mha)</th><th rowspan="2">Rice Fallow Area (Mha) available for Oilseed Cultivation (1/3)</th><th rowspan="2">Suitable crops</th><th>Yield, t/ha</th><th rowspan="2">Potential Production utilizing Rice fallow (MT)</th></tr>
<tr><th>(2017-2022)</th></tr>
<tr><td rowspan="6">MP + Chhattisgarh</td><td rowspan="6">4.38</td><td rowspan="6">1.46</td><td rowspan="2">Linseed</td><td>Madhya Pradesh = 0.67</td><td rowspan="2">0.24</td></tr>
<tr><td>Chhattisgarh = 0.30</td></tr>
<tr><td rowspan="2">Sesame</td><td>Madhya Pradesh = 0.15</td><td rowspan="2">0.14</td></tr>
<tr><td>Chhattisgarh = 0.41</td></tr>
<tr><td rowspan="2">Mustard</td><td>Madhya Pradesh = 1.49</td><td rowspan="2">0.47</td></tr>
<tr><td>Chhattisgarh = 0.46</td></tr>
<tr><td rowspan="8">Bihar + Jharkhand</td><td rowspan="8">2.2</td><td rowspan="8">0.73</td><td rowspan="2">Linseed</td><td>Bihar = 0.84</td><td rowspan="2">0.13</td></tr>
<tr><td>Jharkhand= 0.58</td></tr>
<tr><td rowspan="2">Sunflower</td><td>Bihar =1.43</td><td rowspan="2">0.18</td></tr>
<tr><td>Jharkhand=0.54</td></tr>
<tr><td rowspan="2">Safflower</td><td>Bihar =0.78</td><td rowspan="2">0.12</td></tr>
<tr><td>Jharkhand=0.54</td></tr>
<tr><td rowspan="2">Mustard</td><td>Bihar =1.22</td><td rowspan="2">0.18</td></tr>
<tr><td>Jharkhand=0.78</td></tr>
<tr><td rowspan="6">West Bengal</td><td rowspan="6">1.72</td><td rowspan="6">0.57</td><td>Groundnut</td><td>2.46</td><td>0.24</td></tr>
<tr><td>Linseed</td><td>0.4</td><td>0.04</td></tr>
<tr><td>Sesame</td><td>0.85</td><td>0.08</td></tr>
<tr><td>Sunflower</td><td>1.18</td><td>0.11</td></tr>
<tr><td>Safflower</td><td>0.97</td><td>0.09</td></tr>
<tr><td>Mustard</td><td>1.21</td><td>0.12</td></tr>
<tr><td rowspan="6">Odisha</td><td rowspan="6">1.22</td><td rowspan="6">0.41</td><td>Groundnut</td><td>1.67</td><td>0.11</td></tr>
<tr><td>Linseed</td><td>0.49</td><td>0.03</td></tr>
<tr><td>Sesame</td><td>0.26</td><td>0.02</td></tr>
<tr><td>Sunflower</td><td>1.28</td><td>0.09</td></tr>
<tr><td>Safflower</td><td>0.74</td><td>0.05</td></tr>
<tr><td>Mustard</td><td>0.31</td><td>0.02</td></tr>
<tr><td rowspan="6">Maharashtra</td><td rowspan="6">0.63</td><td rowspan="6">0.21</td><td>Groundnut</td><td>1.18</td><td>0.04</td></tr>
<tr><td>Linseed</td><td>0.34</td><td>0.01</td></tr>
<tr><td>Sesame</td><td>0.21</td><td>0.01</td></tr>
<tr><td>Sunflower</td><td>0.42</td><td>0.01</td></tr>
<tr><td>Safflower</td><td>0.67</td><td>0.02</td></tr>
<tr><td>Mustard</td><td>0.34</td><td>0.01</td></tr>
<tr><td rowspan="2">Assam</td><td rowspan="2">0.54</td><td rowspan="2">0.18</td><td>Linseed</td><td>0.61</td><td>0.05</td></tr>
<tr><td>Mustard</td><td>0.66</td><td>0.06</td></tr>
</table>

States	Area Under Rice Fallow (Rabi) (Mha)	Rice Fallow Area (Mha) available for Oilseed Cultivation (1/3)	Suitable crops	Yield, t/ha (2017-2022)	Potential Production utilizing Rice fallow (MT)
Uttar Pradesh	0.35	0.12	Linseed	0.64	0.07
			Sunflower	1.38	0.16
			Mustard	1.41	0.16
Andhra Pradesh	0.31	0.1	Groundnut	0.96	0.02
			Sesame	0.27	0.01
			Sunflower	0.78	0.02
			Safflower	0.57	0.01
			Mustard	0.49	0.01
Total oilseed production	11.65	3.88			3.12

***Source:** Author's calculation*

5.5 Technological Interventions: Vertical Expansion of Primary Oilseeds

Frontline demonstrations across various oilseed crops indicate that advanced and improved technological interventions and effective and efficient management practices (i.e., crop management, pest and disease control, fertilizer application) can significantly improve productivity.

The significant yield gap between current farmer practices and improved technologies presents a tremendous opportunity to increase domestic edible oil production in India. Frontline demonstrations across various oilseed crops have confirmed this potential. By adopting advanced and improved technological interventions (Figure 5.2), coupled with effective management practices (i.e., crop and water management, pest and disease control, fertilizer application), India can significantly enhance oil crop yields. Improved seed varieties, modern farm machinery, and optimal agronomic practices all contribute to increased productivity. For instance, implementing efficient crop management strategies like crop rotation, timely planting, effective weed control, proper irrigation practices, balanced application of nutrients, and robust pest protection can show substantial results. Continuous cultivation without crop rotation depletes soil nutrients and increases pest susceptibility, leading to yield losses of up to 40%. Improved pest and disease management practices are crucial to addressing the challenge of over major diseases and pests affecting oilseed crops, where resistant sources are often limited. Finally, fertilizer management requires careful consideration of residual effects (phosphorus, potassium, and sulphur), particularly in intercropping systems, to ensure that the nutrient needs of both primary and secondary crops are met, ultimately enhancing overall system productivity.

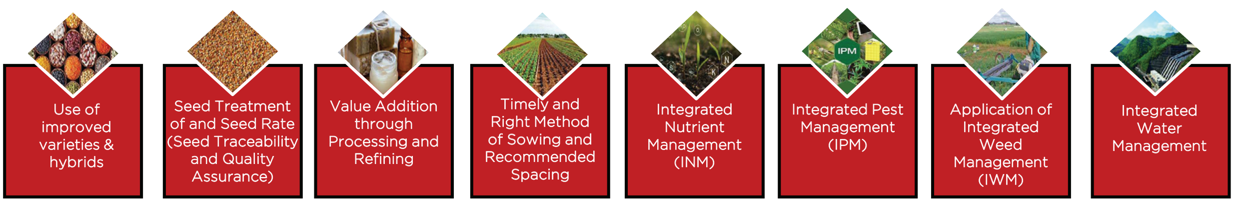


Figure 5.2: Technological Interventions

The results of 23,118 frontline demonstrations (FLDs) during 2010-2015 conducted on nine oilseed crops under real farm situations in different agro-ecological conditions of India over a period of five years [FLDs conducted by National Mission on Oilseeds and Oil Palm (NMOOP)][8] , revealed a significant yield gap between current farmer practices and Improved Technologies (IT)[9] for nine key oilseed crops[10]. This gap ranged from 12% in castor to a substantial 96% in sunflower (Table 5.10). By bridging this gap through widespread adoption of existing, proven technologies, domestic oilseed production could be significantly increased by an estimated 33% (i.e., 12.5 MT). This not only translates to 2.8 MT reduction (i.e., 19.3% of the 14.4 MT demand-supply gap) in India's dependence on edible oil imports but also enhances profitability for oilseed farmers, promoting a more self-sufficient and resilient agricultural sector. Achieving self-sufficiency in edible oil production necessitates the implementation of a dedicated program that incorporates a comprehensive set of improved technologies, including advanced seed varieties, modern farm machinery, high-quality planting seeds, and optimal agronomic practices. For instance, data from the All India Coordinated Research Projects (AICRPs) and field demonstrations conducted by ICAR-IISR suggest that soybean yield has the potential to reach 2 t/ha. Maintaining current soybean acreage under this scenario could result in a production of 24 MT of soybeans by 2035, translating to an additional 4.4 MT of soybean oil. Furthermore, with a nationwide soybean yield of 2 t/ha, domestic oilseed production could increase by a further 13% (i.e., 4.93 MT) from its current level. This translates to a cumulative reduction of 25.7% demand-supply gap, India's dependence on edible oil imports. These figures underscore the transformative potential of technological advancements in bridging the edible oil gap and achieving self-sufficiency for India.

Table 5.10: Oilseeds Potential Yield & Production through Improved Technology (IT) Adoption and Gap with Current Production

Oilseeds	National Average Yield (t/ha) (2017/18-2021/22)	Improved Technology Yield (t/ha)	Potential Increase of Yield Adopting Improved Technology (%)	Actual Production (2021-22) (MT)	Potential Production Adopting Improved Technology (MT)	Gap between Potential and Actual Production (MT)
Groundnut	1.77	2.26	28	10.14	12.98	2.84
Soybean*	1.04	2	92	12.99	24.94	11.95
Rapeseed & Mustard	1.46	1.69	16	11.96	13.87	1.91
Sunflower	0.89	1.74	96	0.25	0.49	0.24
Sesame	0.47	0.54	15	1.62	1.87	0.25
Safflower	0.7	1.06	51	0.03	0.05	0.02
Niger	0.31	0.41	30	0.06	0.08	0.02
Castor	1.81	2.03	12	0.79	0.88	0.09
Linseed	0.6	1.09	81	0.13	0.24	0.11
Total	NA	NA	NA	37.96	55.39	17.43

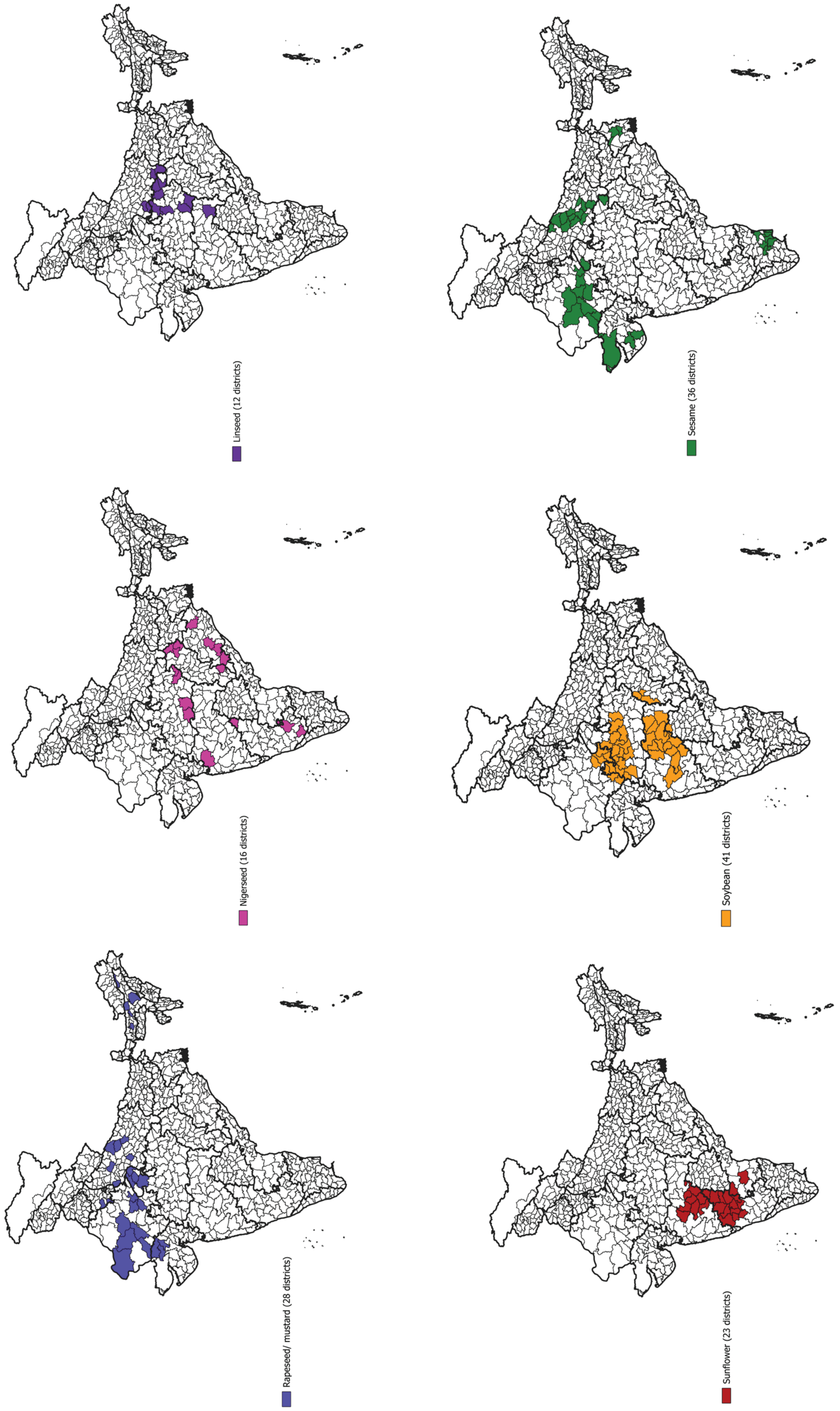
***Source:** Authors' estimations based on the results of FLDs conducted by the National Mission on Oilseeds and Oil Palm (NMOOP)*

***Note:** *Based on data from the All India Coordinated Research Projects (AICRPs) and FLDs (ICAR-IISR)*

8. The major objective of Front-Line Demonstrations (FLDs) is to demonstrate the productivity potentials and profitability of the latest and improved oilseed production technologies under real farm conditions.

9. Use of healthy and disease tolerant seeds, seed treatment, timely sowing, right method of sowing, timely weeding, integrated pest management (IPM), recommended spacing, improved varieties and hybrids, recommended crop sequence, application of gypsum, application of sulfur and boron, spraying of cycocel, integrated nutrient management (INM), integrated weed management (IWM), and integrated water management.

10. https://nfsm.gov.in/ReadyReckoner/NMOOP/NMOOPVol1.pdf



Map 5.3: Key Hotspot Areas Requiring Urgent

Source: IIOR, Hyderabad

5.5.1 Key Hotspot Areas Requiring Urgent Technological Integration

To guide targeted technology dissemination efforts, key hotspot areas requiring immediate interventions have been identified and presented in Map 5.3 (A detailed list of Districts /

Divisions / Regions is provided in Annexure-III). Strategically focusing on technology infusion within these hotspots, may accelerate the adoption of improved practices and maximize the impact on overall domestic oilseed production.

5.5.2 Strengthening the Foundation: Seeds and Processing Infrastructure

Beyond advanced technologies, optimizing seed utilization and processing capabilities are critical aspects of strengthening the foundation for edible oil self-sufficiency. Studies indicate that high-quality seeds alone can contribute significantly (15-20%) to increased production, with the potential to reach even higher levels (45%) when combined with efficient management of other agricultural inputs (Seednet.gov.in). However, the current Seed Replacement Ratio (SRR) falls short of the target of 80-85%, ranging from 25% in groundnut to 62% in rapeseed mustard (Table 5.11), hindering overall yield as highlighted by the National Seed Corporation (NSC). Strategies to improve seed availability and encourage farmer adoption of these improved varieties are essential.

Table 5.11: Certified/quality SRR of oilseed crops (in %) from 2013-14 to 2021-22

Crop	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Groundnut	25.38	23.65	23.56	25.24	23.53	22.44	26.71	24.24	25.02
Rapeseed & Mustard	51.28	54.56	62.2	68.03	54.86	52.41	60.64	57.36	62.96
Sesame	23.62	19.48	30.92	42.36	37.44	39.54	43.64	42.89	46.12
Sunflower	86.29	96.32	86.2	30.67	32.23	30.27	43.07	47.36	39.43
Soybean	37.46	30.48	37.74	38.17	39.92	37.45	41.04	34.21	36.84
Castor	41.06	42.94	54.12	80.8	95.4	54.04	61.31	56.23	59.33
Safflower	32.91	29.05	29.52	29.32	26.58	36.74	33.82	21.46	32.63

***Source:** Crop Science Division, Indian Council of Agricultural Research*

Further, the Indian vegetable oil sector also presents an opportunity for improvement. Currently characterized by a large number of small-scale, low-technology plants with substantial excess capacity, this sector utilizes only 30% of its edible oil refining capacity (Table 5.12). Modernizing existing mills and strategically investing in processing infrastructure will be instrumental in improving efficiency and minimizing waste. By addressing these foundational challenges alongside technological advancements, India can unlock the full potential of its domestic edible oil production capabilities.

Table 5.12: Present status of Indian Vegetable oil industry

S. No.	Category	No. of units	Annual capacity (MT)	Capacity utilization (%)
1	Oil Mills (Crushing Units)	15,000	36	20-30
2	Solvent Extraction Plants	600	31	40
3	Vegetable Oil Refineries	650	30	50
4	Vanaspati (Hydrogenated Units)	250	3	40
5	Feed units	125	68	45

Source: SEA data bank

5.6: The Potential of Secondary Edible Oils

While optimizing primary oilseed production through horizontal and vertical expansion strategies holds promise, achieving self-sufficiency in edible oils demands a more diversified approach. This necessitates exploring the untapped potential of secondary edible oil sources. While strategic interventions for primary oilseeds including crop diversification and retention of cultivated areas, efficient rice fallows utilization, well-organized management (i.e., crop, pest & disease, and fertilizers), and improved or advanced technologies hold promise, they represent only one facet of a comprehensive approach. The focus on primary oilseeds only has the potential to increase total edible oil production by 6.8 MT, leading to a significant 47% reduction in the estimated demand-supply gap of base year or import dependence. However, unlocking the potential of secondary edible oils with substantial production potential is crucial.

The following sections will explore opportunities and strategies associated with secondary edible oils, a relatively untapped domestic resource with substantial production potential. Palm oil with its vast areas of suitable yet unutilized land for potential cultivation and its inherently high yield can play significantly in augmenting domestic production and reducing import reliance. By strategically optimizing both primary and secondary sources alongside targeted palm oil cultivation development, India can significantly strengthen and diversify its edible oil sector and progress towards self-sufficiency.

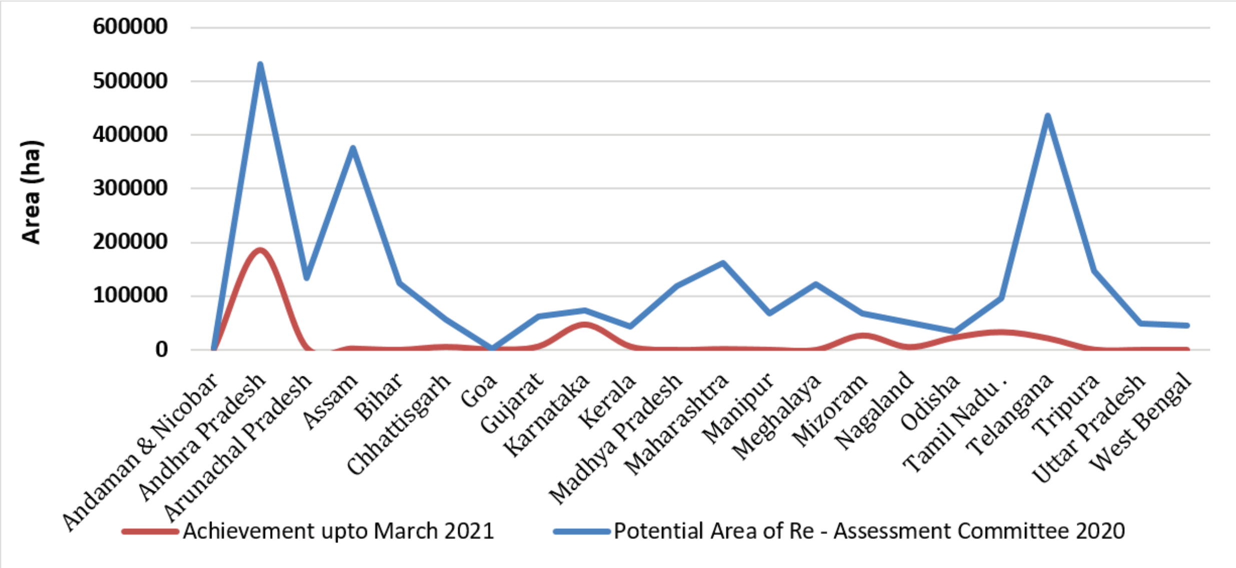
Amongst the secondary sources of edible oil, rice bran oil stands out for its rising popularity among urban consumers due to its perceived health benefits, including reducing the risk of heart disease and type 2 diabetes. Rice bran, constituting approximately 8.5% of total rice production with 17% oil content, offers an estimated potential of 1.9 MT of edible oil, with an untapped reserve of 0.85 MT. This translates to a potential 5.9 % reduction in the demand-supply gap. Similarly, cottonseed presents a promising avenue, with an untapped potential of about 1.4 MT of additional edible oil production. This untapped potential from cottonseed could contribute to a further 9.7% reduction in the edible oil demand-supply gap or country's import dependence.

5.6.1. Prioritizing Palm Oil: A Strategic Approach

India's focus on horizontal expansion for oil palm cultivation is a strategic imperative in the government's on-going efforts to enhance domestic edible oil production and reduce import reliance. This strategy has yielded significant results. Over the past three decades, the oil palm cultivation area has witnessed a remarkable expansion, growing from a mere 8,585 hectares in 1991-92 to 0.37 Mha in 2021-22. This substantial increase in cultivated area has directly translated into a notable rise in the production of Fresh Fruit Bunches (FFBs) and Crude Palm Oil (CPO).

While Andhra Pradesh, Telangana, and Kerala currently dominate oil palm production, contributing to 98% of the national total, the landscape is evolving. States like Karnataka, Tamil Nadu, Odisha, Gujarat, and Mizoram also boast substantial cultivated areas. Furthermore, recent initiatives from Government of India in North-East (NE) states such as Arunachal Pradesh, Assam, Manipur, and Nagaland highlight a growing nationwide interest in oil palm plantation programs. These developments suggest a promising trajectory for geographically diversified palm oil production in India. A reassessment by the ICAR-Indian Institute of Oil

Palm Research (IIOPR) in 2020 identified a substantial 2.8 Mha of land suitable for oil palm cultivation across India (Figure 5.3). This potential is distributed between general states (1.84 Mha) and NE states (0.96 Mha). However, current NE coverage stands at a mere 0.004 Mha, highlighting a significant underutilization of this region's potential.



Source: *ICAR-IIOPR, 2020*

Figure 5.3: Potential Area (ICAR- IIOPR Reassessment committee, 2020) and achieved area (up to March 2021) of palm in India

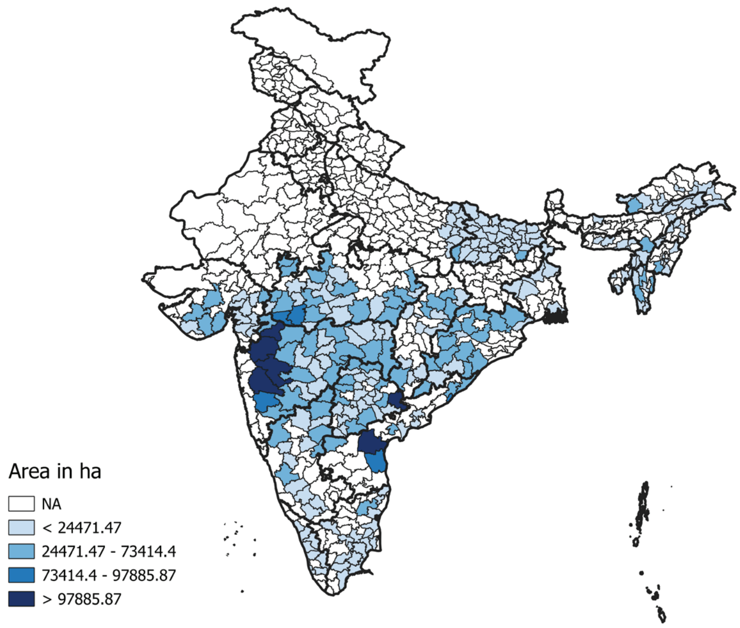
Oil palm cultivation offers a strategic advantage in terms of yield. A detailed analysis reveals that while traditional oilseeds require a land area of 15.80 Mha to produce 4 MT of oil, the same quantity of palm oil can be produced from just 1 Mha. In simpler terms, 1 Mha dedicated to oil palm cultivation yields the equivalent output of over 15 Mha under traditional oilseeds.[11] Furthermore, with quality planting materials, irrigation and proper management, oil palm has the potential to produce 20-25 MT fresh fruit bunches (FFBs) per ha after attaining the age of 8-9 years. This translates to a potential output of 4-5 t/ha of palm oil and 0.4-0.5 t/ha of palm kernel oil (PKO), 4.5 times the yield of other traditional oilseeds, on average. Through repeated crossing and selection for a period of three decades, India has achieved a stage of third-generation planting material with 15-20% improvement in FFB yield, and 5-6 t/ha of oil annually[12] .

Oil palm's significant yield advantage, coupled with efficient land utilization, solidifies its position as a strategic crop for boosting domestic edible oil production. Therefore, prioritizing horizontal expansion efforts for oil palm cultivation is crucial for India's journey towards self-sufficiency (*Atmanirbharta*). Efforts should focus on capitalizing on the substantial untapped potential identified by ICAR-IIOPR in the 284 districts, which estimates an additional 2.43 Mha of land across India for the oil palm cultivation. Furthermore, tactically utilizing two thirds of the highly suitable areas of wastelands located in ICAR-IIOPR identified districts (i.e., 6.18 Mha) with the target of 0.34 Mha annually across the country for the next 18 years till 2042, presents a significant opportunity for further horizontal expansion (Map 5.4). A strategic approach combining horizontal and vertical expansion, leveraging the untapped

11. https://iiopr.icar.gov.in/pdf/vision2050.pdf

12. https://nfsm.gov.in/Guidelines/NMEO-OPGUIEDELINES.pdf potential, has the potential to increase total edible oil production by 9.7 MT (from 2.43 Mha) and 24.7 MT from utilizing highly suitable areas of wastelands (i.e., 6.18 Mha) with a conventional yield assumption of 4 t/ha. Palm oil alone, through targeted expansion in these identified areas, can potentially increase a staggering 34.4 MT of edible oil, making a substantial stride towards closing the existing demand-supply gap.

Beyond boosting domestic production and reducing import dependence, the NMEO-OP scheme also holds the potential to benefit oil palm farmers through increased capital investment, job creation, and improved incomes (Annexure-VII). By prioritizing oil palm expansion and efficiently implementing strategic initiatives like NMEO-OP, India can make significant strides toward achieving *Atmanirbharta* in the edible oil sector.



Map 5.4: District wise Highly Suitable Areas from Wastelands for Palm Oil Cultivation

5.7 Potential Increase in Edible Oil Production through Strategic Interventions

India's rising edible oil import dependence, reaching a staggering 16.5 MT in 2022-23, necessitates a multi-pronged strategy to achieve self-sufficiency (*Atmanirbharta*) in this sector. With domestic production currently meeting only 43% of the nation's needs, the remaining 57 % is met through imports. However, the outlined strategies and interventions, encompassing both horizontal and vertical expansion approaches, offer a vibrant path towards reducing this import dependence. By implementing these strategies and interventions in a well-coordinated manner, India has the potential to significantly increase domestic edible oil production, to an estimated increase of 43.5 MT in edible oil production as detailed in Table 5.13. This substantial increase has the potential to not only bridge the import gap but also position India on a trajectory towards self-sufficiency in edible oils.

Table 5.13: Potential Increase in Edible Oil Production through Strategic Interventions (MT)

Oil Crops	Potential Increase in Edible Oil Production (MT)		
	Strategic Crop Diversification and Retention	Horizontal Expansion (efficient rice fallows utilization)	Vertical Expansion (improved or advanced technologies and well-organized management)
Groundnut	0.26	0.06	0.39
Soybean	0.31	NA	2.35
Rapeseed & Mustard	1.45	0.4	0.74
Sunflower	0.02	0.22	0.09
Castor	NA	NA	0.12
Nigerseed	NA	NA	0.003
Safflower	NA	0.09	0.01
Sesame	0.02	0.05	0.02
Linseed	NA	0.23	0.04
Primary Total	2.1	1.03	3.7
Palm oil	NA	34.4	
Coconut	NA	NA	NA
Cottonseed	NA	1.4	
Rice bran	NA	0.85	
Secondary Total	NA	36.7	
Grand Total	43.5		

Source: *Authors' estimations*

The outlined strategies for increasing domestic edible oil production through strategic interventions hold immense potential. By 2030 and 2047, these interventions could lead to a projected edible oil supply of 36.2 MT and 70.2 MT, respectively (Table 5.14), achieving self-sufficiency under the Normative Approach and the Household Approach. In fact, these scenarios project a surplus in edible oil supply in both approaches – 20.3 MT and 52.8 MT under the Normative Approach and 6.1 MT and 37.6 MT under the Household Approach.

Acknowledging the potential impact of changing dietary patterns, the Behaviouristic Approach offers a more nuanced perspective on India's future edible oil needs. Scenario-I, which assumes an average developed-world consumption level of 25.3 kg/person/year, projects a small import gap of 2.1 MT in 2030. However, this gap is projected to close entirely by 2047, with a surplus of 28.3 MT achievable by then (Table 5.14). Scenario II, based on the highest observed consumption level of 40.3 kg/person/year (i.e., United States), presents a more concerning picture in the near term. Under this scenario, a significant gap of 9.3 MT is projected by 2030. However, even this scenario suggests the potential for achieving self-sufficiency in the long term, with a projected surplus of 3.4 MT by 2047 (Table 5.14). These projections highlight the importance of not only increasing domestic production but also considering potential shifts in consumption patterns when formulating long-term strategies for achieving edible oil self-sufficiency.

Table 5.14: Projected Edible Oils Demand-Supply Gap at National Level by 2030 and 2047 (in MT) adding Potential Increase through Strategic Interventions: Household Approach, Normative Approach, and Behaviouristic Approach (Scenario- I & II)

Year	Projected Supply through Strategic Interventions (MT)	Household Approach		Normative Approach		Behavioristic Approach (Scenario I)		Behavioristic Approach (Scenario II)	
		Demand (MT)	GAP (MT)	Demand (MT)	GAP (MT)	Demand (MT)	GAP (MT)	Demand (MT)	GAP (MT)
2030	36.2	30.1	6.1	15.9	20.3	38.3	-2.1	45.5	-9.3
2047	70.2	32.6	37.6	17.4	52.8	41.9	28.3	66.8	3.4

***Source:** Authors' estimations*

To bridge the potential import gap projected under the Behaviouristic Approach, particularly in the near term, the significant production increase envisioned through strategic interventions needs prioritized implementation. Realizing this ambitious target will necessitate a focused approach that leverages the "Quadrant Strategy" on a state-wise cluster basis. This data-driven strategy involves identifying and exploiting the potential opportunities within each state cluster for specific edible oil crops. It emphasizes a scalable approach that prioritizes not only clusters with LA-LY but also those with HA-LY and LA-HY potential. By strategically targeting these clusters and implementing tailored interventions, India can maximize its production potential and effectively address the near-term challenges posed by potential consumption increases.

Over the past five years (2016-17 to 2021-22), India's edible oil sector has witnessed a CAGR of about 3%. This existing growth trend serves as a baseline. When considering a BAU scenario with current production levels maintained, this recent growth trend might be sufficient to meet the demand projected by the Normative Approach. It indicates that India could potentially meet its edible oil needs based on recommended intake levels if production continues on its current trajectory. However, achieving self-sufficiency in edible oils necessitates a more ambitious strategy. Under the Household Approach, which factors in population growth, to meet the projected demand by 2030 a significantly higher CAGR of 9.5% would be required for the 2021-2030 period. Even for the longer-term goal of self-sufficiency by 2047, a slightly elevated CAGR of 3.5% for the entire 2021-2047 period would be necessary (Table 5.15).

The Behaviouristic Approach introduces another layer of complexity by considering potential changes in consumption pattern driven by rising income levels, changes in lifestyles and dietary patterns, and prices. Scenario-I, representing an average developed-world consumption level, necessitates significantly steeper CAGRs to achieve self-sufficiency. In this scenario, CAGRs of 12.5 % for the 2021-2030 period and 4.5 % for the 2021-2047 period would be required to meet the projected demand by 2047, respectively. Scenario-II, based on the highest observed consumption level, presents the most challenging scenario. Here, self-sufficiency by 2030 and 2047 necessitates even steeper CAGRs of 14.6 % for the 2021-2030 period and 6.4 % for the entire 2021-2047 period (Table 5.15). These findings highlight the critical need for strategic interventions to accelerate domestic production and bridge the gap between current growth trends and long-term self-sufficiency goals.

Table 5.15: Required CAGR for Edible Oil Self-Sufficiency: Considering BAU & Strategic Interventions Scenarios across Normative, Household & Behaviouristic Approaches (Scenario- I & II)

Required CAGR	Household Approach		Normative Approach		Behaviouristic Approach (Scenario I)		Behaviouristic Approach (Scenario II)	
	2021-2030	2021-2047	2021-2030	2021-2047	2021-2030	2021-2047	2021-2030	2021-2047
Scenario I: Existing Production Level (without Strategic Interventions)	9.50%	3.50%	Recent growth trend (CAGR of 3%) would be sufficient to meet the projected demand		12.50%	4.50%	14.60%	6.40%
Scenario II: Existing Production Level combined with the Potential Increase through Strategic Interventions	Recent growth trend (CAGR of 3%) would be sufficient to meet the projected demand						5.20%	Recent growth trend (CAGR of 3%) would be sufficient to meet the projected demand

Source: *Authors' estimations*

The proposed strategic interventions, if implemented effectively, hold significant promise for India's edible oil sector. These measures have the potential to substantially increase domestic production, moving the country to its goal of self-sufficiency. These gains, combined with the existing production level is anticipated to achieve self-sufficiency with the recent growth trend (CAGR of 3%) in all scenarios except for the most demanding scenario (i.e., Behaviouristic Approach Scenario-II based on the highest observed consumption level) in near term. To meet the projected demand by the more immediate target of 2030 under this scenario, a CAGR of 5.2% would be required for the 2021-2030 period, representing a 2.2% increase from the recent growth situation. These targeted increases can be achieved through a more focused and rigorous implementation of the proposed strategic interventions. This more intensive approach has the potential to pave the way for India to achieve *Atmanirbharta* (self-reliance) in its edible oil sector, ensuring a secure and sustainable future for its edible oil needs.

Pathways and Strategy for Accelerating Growth in Edible Oil towards Goal of Atmanirbharta

CHAPTER-VI

RECOMMENDATIONS AND WAY FORWARD

RECOMMENDATIONS AND WAY FORWARD

Achieving self-sufficiency in edible oils is a critical national priority for India. To navigate this path successfully, a strategic approach that addresses key challenges and leverages existing resources is essential. Recognizing this need, NITI, Aayog conducted a primary field survey encompassing 1,261 farmers across seven major oilseed-growing states (Rajasthan, Maharashtra, Madhya Pradesh, Uttar Pradesh, Haryana, Andhra Pradesh, and Karnataka) (Annexure-IV). The valuable insights gained from this survey, coupled with a comprehensive strategy and roadmap outlined in the previous chapters, the following recommendations are laid down. These recommendations are designed to bolster India's domestic edible oil sector, fostering self-reliance and long-term stability.

6.1 Focus on Area Retention of Oilseeds and diversification

i. **Crop Clusters and Technology Customization:** Crop-wise clustering integrates horizontal and vertical expansion efforts for targeted growth. States are categorized into four clusters (HA-HY, HA-LY, LA-HY, and LA-LY) based on area and yield performance for each oilseed crop, enabling nuanced growth strategies (see Chapter-V for detailed lists). Develop customized cluster technology for yield improvement and establish Agro-Ecological Sub Region (AESR)-based crop-specific model farms to facilitate the horizontal spread of advanced technologies.

ii. **Horizontal Expansion in Rice Fallow:** Utilizing one-third of the total Rabi rice fallow area across ten states for oilseed cultivation has the potential production of additional 1.03 MT, representing a significant 7.1% reduction in India's import reliance. To ensure the economic viability and large-scale implementation of this strategy across the potential states, exploration of the economic feasibility of large-scale cultivation and identification of the optimal crop selection for different regions is critical.

iii. **Enhancing oilseed Development in Bundelkhand and the Indo-Gangetic Plain**: Revitalizing the Bundelkhand region in Madhya Pradesh and Uttar Pradesh, suitable for oilseeds cultivation, is crucial. Prioritizing technology interventions, especially promoting sesame cultivation tailored to the region's conditions, can significantly boost farm incomes. Additionally, diversifying the rice-wheat cropping system in the Indo-Gangetic Plain (IGP) by introducing soybean, rapeseed-mustard, and sunflower in select agro-ecological regions offers farmers increased profitability addressing ground water depletion and soil health degradation issues.

iv. **Prioritizing Wasteland Utilization for Oil Palm Horizontal Expansion:** Prioritizing a strategic approach to horizontal expansion of oil palm cultivation, leveraging highly suitable underutilized wastelands is recommended. This strategy can be fostered through inclusive partnerships involving FPOs, FPCs, SHGs, etc., engaged in long-term contracts. Specifically, utilizing two-thirds of the total highly suitable areas of wastelands located in ICAR-IIOPR identified districts (i.e., 6.18 Mha) presents a significant opportunity for large-scale expansion. This approach has the potential to increase total edible oil production by an estimated 24.7 MT, making a significant stride towards closing the existing demand-supply gap and reducing dependence on imports.

6.2 Seed Traceability and Quality Assurance

i. **Cluster-Based Seed Village:** Establishment of cluster-based seed hubs at block levels "One Block-One Seed Village" to supply high quality seeds for oilseeds aiming to enhance seed replacement rate (SRR) and varietal replacement rate (VRR). Setting up a resilient system for these hubs will guarantee farmers access to high-quality oilseeds through Farmers' Producer Organizations (FPOs) in a timely manner.

ii. **Promotion of bio fortified oilseed varieties:**

- Biofortification must be part of the national oil missions to address micronutrient malnutrition by enhancing oleic acid in groundnut and soybean, linoleic acid in linseed, and reducing anti-nutritional factors like erucic acid and glucosinolates in mustard, and trypsin inhibitor and lipoxygenase in soybean.
- ICAR has released 14 biofortified oilseed varieties (mustard: 6, soybean: 5, linseed: 1, groundnut: 2). Research institutions should produce more breeder seeds and provide them to state governments, aiming for a 10-12% annual adoption rate of bio fortified varieties by farmers.

iii. **State-Level Seed Rolling Plans and Harmonizing Seed Quality Standards:** State governments are crucial in initiating breeder seed production through indent requests. To ensure access to improved varieties, states should develop five-year seed rolling plans. These plans prioritize replacing outdated oilseed varieties with high-yielding, bio-fortified, and disease-resistant alternatives. Harmonizing Indian Minimum Seed Certification Standards (IMSCS) with the Economic Co-operation and Development (OECD) and the International Seed Testing Association (ISTA) standards ensures Indian oilseeds meet global quality requirements, facilitating international trade opportunities.

iv. **Enhancing Yield through Improved Varieties: Genetic Potential:** Existing technologies offer substantial opportunities to boost oilseed yields. Newly developed Indian varieties, detailed in Table 6.1, demonstrate genetic potential on par with top-performing countries globally. Scaling up production of these high-potential varieties and ensuring widespread distribution of their progeny are crucial steps forward. New breeding techniques such as fast-track breeding, genomic selection, genome editing, and gene introgression must be adopted to improve both yield and quality of oil.

Table 6.1: Comparison of Genetic Potential of Newly Bred Indian Oilseed Varieties with the Country with Highest Yield (t/ha) Globally

Crop	States with highest yield	Country with highest yield	Genetic potential of newly bred Indian varieties
Groundnut	2.2 (Gujarat)	3.84 (China)	3.5-4
Rapeseed-Mustard	1.58 (Rajasthan)	2.17 (Canada)	3-3.5
Soybean	1.26 (Maharashtra)	3.20 (Brazil)	2.2-2.8
Sunflower	1.27 (Odisha)	2.25 (Ukraine)	2-2.5
Safflower	0.82 (Karnataka)	0.71 (Kazakhsthan)	1-1.2
Linseed	0.67 (Madhya Pradesh)	0.86 (Russia)	1.2-1.6
Sesame	0.82 (West Bengal)	0.28 (Sudan)	1-1.5

***Source:** Yield computation (2017-2022) from MoAF&W Genetic potential of varieties: NAAS, 2022*

6.3 Adoption of Improved and Advanced Production Technologies

Bridging the yield gap, which ranges from 12% in castor to 96% in sunflower, technology improvements can raise national oilseed production by an estimated 46%, resulting in approximately a 26% decrease in import reliance.

Crop improvement strategies should prioritize maximizing genetic potential by integrating conventional breeding techniques with modern biotechnological tools. Specifically, a focused approach on heterosis breeding to exploit hybrid vigour is essential for crops like sunflower, castor, rapeseed-mustard, safflower, and sesame.

6.4 Value Addition through Processing and Refining

i. **Harnessing Rice Bran Oil for Domestic Blending:** The rice bran industry offers substantial potential for domestic edible oil production, capable of yielding nearly a million tons of oil suitable for blending with popular cooking oils. Collaboration with other major rice-producing countries is essential to standardize regulations for rice bran oil under the Codex Committee on Fats and Oils of the Joint WHO-FAO Food Standards Programme, facilitating its large-scale utilization.

ii. **Enhancing Efficiency in the Solvent Extraction Industry**: The solvent extraction industry, despite rapid expansion, faces challenges due to low capacity utilization (around 30%) requires addressing geographical imbalances in plant distribution and promoting modernization. Optimizing oil extraction through enhanced mill management practices is essential, aiming to achieve at least 60% annual capacity utilization for increased efficiency in domestic edible oil production.

6.5 Effective Marketing and Robust Market Linkages

i. **Optimizing Storage Strategies and Price Incentives:** Balancing off-season storage profitability with consumer affordability is key. Implementing fair pricing structures ensures adequate margins for storage costs, interest, and stakeholder returns, promoting market stability while incentivizing off-season sales.

ii. **Enhancing Marketing Infrastructure:** To improve the realizable income of oilseed farmers, ensuring procurement at the Minimum Support Price (MSP) through NAFED (National Agricultural Cooperative Marketing Federation of India) and state-owned oilseeds federations is essential. Furthermore, facilitating direct marketing of output with NAFED/state-owned oilseed federations can act as a catalyst for promoting oilseed cultivation in non-traditional areas of the country.

iii. **Setting Up Testing Laboratories in the Mandis:** Indian oilseed markets lack a scientific approach, with traders relying solely on visual inspection. This subjectivity leads to inconsistencies in pricing and disadvantages producers of higher-quality oilseeds. Establishing standardized quality parameters and implementing mandatory testing procedures at mandis (agricultural markets) is vital to address this gap. Testing laboratories may setup in PPP mode utilizing expertise of agricultural universities and ICAR institution.

iv. **Enhancing Oil Palm Sector Efficiency:** Promoting large-scale "captive plantations" and dedicated oil palm "seed gardens" is crucial to boost domestic edible oil production. Declaring oil palm as a plantation crop would streamline regulations and facilitate land allocation. Additionally, enforcing zero-waste policies in processing units ensures byproducts are utilized, potentially converting palm oil mill effluent (POME) into methane for electricity generation and supporting value-added enterprises.

6.6 Encouraging Public-Private Partnerships

i. **Strategic Partnerships for Sustainable Edible Oil production:** Leveraging public-private partnerships is crucial for accelerating edible oil production, utilizing private sector expertise in technology, marketing, seed production, and area promotion across all oilseed crops, including oil palm, with buy-back arrangements. Achieving sustainable oil palm production requires collaboration among government agencies, grower cooperatives, local NGOs, and the private sector, utilizing initiatives like the Roundtable on Sustainable Palm Oil (RSPO) to prioritize biodiversity conservation.

6.7 A Dynamic Trade Policy for Balanced Growth

A flexible tariff structure, responsive to global market prices, domestic supply and demand trends, and the Minimum Support Price (MSP) for oilseeds, offers a strategic approach. Implementing a higher import duty regime can safeguard domestic production, while a substantial duty gap between crude and refined oil will benefit processing industries. Aligning support prices with the import duty structure will support farmers, processors, and consumers alike.

6.8 Broadening the Scope of the National Mission on Edible Oils

To achieve self-sufficiency in edible oils and reduce import dependence, expanding the National Mission on Edible Oils is recommended. This broadened initiative should encompass key oilseeds like mustard, soybean, groundnut, sunflower and sesame. Additionally, exploring the potential of secondary and tree-based oilseed varieties can further diversify domestic production and enhance overall edible oil security. Export avenues for sesame, groundnut and castor oil should be created by addressing quality concerns.

6.9 Strategies for Consumer Preference and Industry

i. **Public Education on Dietary Guidelines:** To foster consumer acceptance of domestically produced edible oils, strategies include culinary workshops targeting chefs, homemakers, influencers leveraging cooking shows to highlight versatility, and public education emphasizing the Recommended Dietary Allowance (RDA) of fats and oils, as established by the World Health Organization (WHO) and the National Institute of Nutrition (NIN), are crucial. These initiatives support SDG 3 (Good Health and Well-Being), along with importance of understanding the financial implications of health expenditures which aims to reduce catastrophic health spending and ensure affordable access to health needs, including nutrition.

ii. **Incentivizing Domestic Oilseed Consumption in the Food Industry:** Encouraging greater use of domestically produced edible oils in the food industry is crucial for strengthening the domestic edible oil sector. Introducing incentive schemes that reward food manufacturers for integrating locally sourced and processed oils into their products has the potential to generate substantial economic benefits.

6.10 Data-Driven Transformation and Research Investment

Addressing disparities in oilseed yields requires a data-driven approach and robust systems to bridge regional gaps. Investing in research and development is crucial for transforming the edible oil sector, offering higher returns than input subsidies.

ANNEXURES

Trends of MSP in oilseeds

ANNEXURE-1

Table A1.1 Trends of MSP in oilseeds (₹ per quintal)

Crops	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	Absolute Change (₹)	Relative Change (%)
Groundnut	4000	4030	4220	4450	4890	5090	5275	5550	5850	6377	6783	2783	69.6
Sunflower Seed	3750	3800	3950	4100	5388	5650	5885	6015	6400	6760	7280	3530	94.1
Soyabean	2560	2600	2775	3050	3399	3710	3880	3950	4300	4600	4892	2332	91.1
Sesamum	4600	4700	5000	5300	6249	6485	6855	7307	7830	8635	9267	4667	101.5
Nigerseed	3600	3650	3825	4050	5877	5940	6695	6930	7287	7734	8717	5117	142.1
Rapeseed/ Mustard	3100	3350	3700	4000	4200	4425	4650	5050	5450	5650	5650	2550	82.3
Safflower	3050	3300	3700	4100	4945	5215	5327	5441	5650	5800	5800	2750	90.2

***Source:** Ministry of Agriculture and Farmer's Welfare*

Projected Population - All India (2021-2047)

ANNEXURE-2

Table A2.1: Projected Population - All India (2021-2047)

Year	Total Population ('000)	Rural population ('000)	Urban population ('000)	Urban (%)
2021	1407564	909385	498179	35.39
2022	1417173	908805	508368	35.87
2023	1428628	909122	519506	36.36
2024	1441720	910201	531519	36.86
2025	1454607	910831	543776	37.38
2026	1467231	910989	556242	37.91
2027	1479579	910651	568928	38.45
2028	1491671	909860	581811	39.04
2029	1503471	908592	594878	39.56
2030	1514994	906845	608149	40.14
2031	1526209	904615	621594	40.72
2032	1537108	901914	635195	41.32
2033	1547690	898728	648962	41.93
2034	1557920	895072	662848	42.54
2035	1567802	890951	676852	43.17
2036	1577303	886381	690922	43.80
2037	1586439	881409	705029	44.44
2038	1595246	876077	719169	45.08
2039	1603665	870405	733260	45.72
2040	1611676	864358	747318	46.36
2041	1619318	858012	761306	47.01
2042	1626585	851355	775231	47.66
2043	1633431	844369	789061	48.30
2044	1639838	837055	802783	48.95
2045	1645863	829466	816398	49.60
2046	1651514	821612	829902	50.25
2047	1656777	813494	843283	50.89

Source: https://databank.worldbank.org/source/population-estimates-and-projections#

Key Hotspot Areas Requiring Urgent Technological Integration

ANNEXURE-3

To guide targeted technology dissemination efforts, key hotspot areas requiring immediate interventions have been identified and presented in Table A3.1.

Table A3.1: Key Areas Requiring Urgent Techwnological Integration

Crop	State	District / Region
Groundnut	Andhra Pradesh	Anantapuram, Chittoor, Kadapa, Kurnool
	Gujarat: Kharif	Amreli, Bhavnagar, Jamnagar, Junagadh, Rajkot, Sabarkantha, Kutch, Porbandar
	Gujarat: Rabi	Bhavnagar, Junagadh, Vadodara, Kutch
	Maharashtra	Dhule, Nashik, Kolhapur, Nasik, Sangli, Satara
	Karnataka	Chitradurga, Tumkur, Bellary, Belgaum
	Rajasthan	Bikaner, Churu, Jaipur, Jodhpur, Sikar
	Madhya Pradesh:	Chhindwara, Shivpuri, Tikamgarh
	Tamil Nadu:	Erode, Namakkal, Pudukottai, Vellore, Villupuram, Salem, Thiruvannamalai
	Telangana	Mahabubnagar, Karimnagar, Nalgonda, Rangareddy, Warangal
Soybean	M.P.	Malwa and Vindhya Plateau
	Maharashtra	Ahmednagar, Akola, Amravati, Beed, Buldhana, Chandpur, Hingoli, Latur, Nagpur, Nanded, Parbhani, Wardha, Washim, Yavatmal Rajasthan: Baran, Bundi, Kota
	Chhattisgarh	Chhattisgarh: Bemetra, Kabirdham, Rajnandgaon
	Telangana	Adilabad
Sesame	Gujarat	Rajkot, Amreli, Kutch
	Rajasthan	Pali, Jodhpur, Jalore, Sawai Madhopur, Sirohi, Bhilwara, Tonk, Nagaur, Ajmer
	Tamil Nadu	Cauvery Delta Zone
	Uttar Pradesh	Central Plain region
	Madhya Pradesh	Sheopur, Singrauli
	West Bengal	Hooghly, Burdwan

Crop	State	District / Region
Rapeseed-Mustard	Rajasthan	Bundi, Pali, Jaisalmer, Jalore, Jodhpur, Nagaur, Sawai Madhopur, Tonk
	Assam	Barpeta, Darrang, Dhemaji, Karbi Anglong, Sonitpur
	Madhya Pradesh	Bhind, Gwalior, Morena, Shivpuri
	Uttar Pradesh	Budaun, Barabanki, Kanpur Dehat, Kheri, Mathura, Sitapur
	Haryana	Bhiwani, Mahendragarh
	Gujarat	Banaskantha, Mehsana, Patan
Sunflower	Karnataka	Northern Karnataka
	Andhra Pradesh	Kadapa, Kurnool
	Maharashtra	Marathwada region
Safflower	Maharashtra	Marathwada region
	Karnataka	Bidar, Yadgir, Raichur, Koppal, Bellary, and Gulbarga
Linseed	Madhya Pradesh	Balaghat, Chhatarpur, Damoh, Rewa, Satna, Seoni, Sidhi
	Uttar Pradesh	Chandrapur (MH); Hamirpur,Mahoba, Mirzapur, Sonbhadra
Nigerseed	Madhya Pradesh	Annupur, Betul, Chhindwara, Dindori
	Karnataka	Bidar, Mysore, Tumkur
	Chhattisgarh	Balrampur, Bastar, Jashpur, Surguja
	Maharashtra	Nasik
	Odisha	Koraput, Kendujhar, Kandhamal, Rayagada

Source: IIOR, Hyderabad

Insights into Oilseed Cultivation: A Survey of Indian Farmers

ANNEXURE- 4

Analysing oilseed production in India, both at the state and all-India levels, is critical for understanding the intricacies of the agricultural sector. This comprehensive examination provides insights into regional strengths, challenges, and opportunities, aiding in formulating targeted policies and strategies. The state-wise analysis delves into specific regional dynamics. At the same time, the all-India perspective offers a holistic view of the oilseed sector, guiding efforts toward achieving self-sufficiency, ensuring food security, and enhancing economic growth. This primary examination serves as a foundation for informed decision-making and sustainable development in the vital domain of oilseed cultivation. This section includes a detailed analysis of 7 oilseed-growing states from a primary survey conducted by NITI Aayog.

1. Sampling Framework of Selected Farmers

The survey of oilseed production in 7 states was conducted to assess the current status of oilseed production in the country. Sampling framework showing selected districts of the sample states is shown in Figure A4.1. The sample size for the survey was 1261 farmers from different states, having different socio-economic profiles, cropping patterns, and land holdings relating to oilseed production (Table A4.1 and Table A4.2).

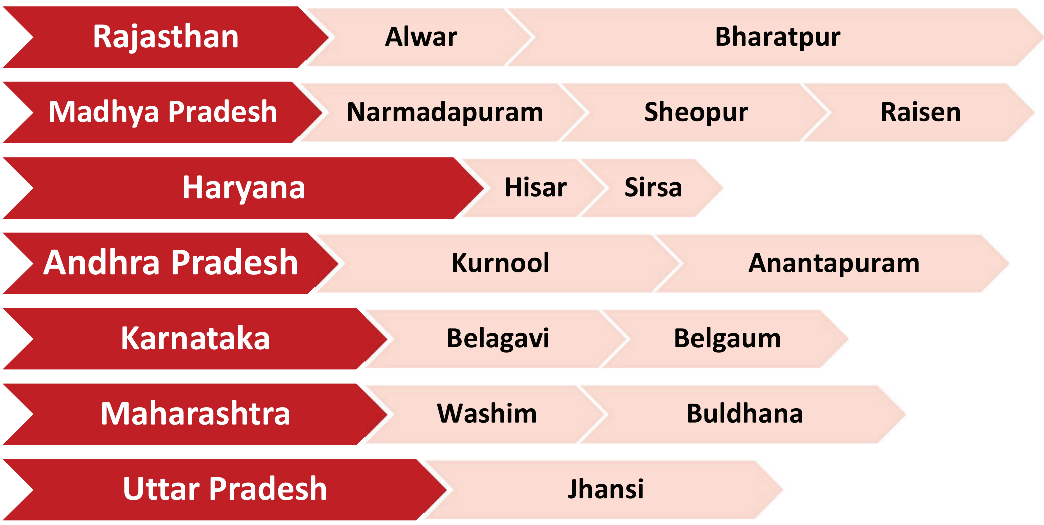


Figure A4.1: Sampling framework showing selected districts of the sample states

The survey also found a significant variation in oilseed production across different states. This variation is due to several factors, including climate, soil type, and irrigation practices. This decline is due to several factors, including the increasing use of fertilizers and pesticides and the adoption of new agricultural technologies. The survey findings suggest a need to improve oilseed production in the country. This can be done by several measures, including developing new oilseed varieties, promoting sustainable agricultural practices, and providing better access to credit and inputs for oilseed farmers.

Table A4.1: Sampling framework for the selected farmers along with crops

Oilseed crop	Selected state	No. of the sample farmers
Soybean	Madhya Pradesh	22
	Maharashtra	142
	Rajasthan	12
	Karnataka	11
Sunflower	Karnataka	30
	Andhra Pradesh	22
	Maharashtra	75
Niger seed	Madhya Pradesh	22
	Maharashtra	41
Rapeseed & Mustard	Rajasthan	100
	Madhya Pradesh	21
	Haryana	194
Safflower	Maharashtra	52
	Karnataka	26
Castor	Rajasthan	5
	Andhra Pradesh	15
Linseed	Madhya Pradesh	25
	Uttar Pradesh	40
Groundnut	Andhra Pradesh	75
	Rajasthan	8
	Karnataka	13
Sesame	Rajasthan	5
	Madhya Pradesh	21
	Uttar Pradesh	51

Table A4.2: Sampling framework with land holdings

State	No. of farmers	Marginal farmers (< 1 ha)	Small farmers (1 to 2 ha)	Semi Medium farmers (2 to 4 ha)	Large farmers (> 4 ha)
Rajasthan	214	9.50%	12.60%	38.60%	9%
Maharashtra	310	44%	28%	27.60%	0.40%
Madhya Pradesh	111	25.80%	19.50%	38.70%	15.80%
Uttar Pradesh	91	28%	34.60%	31.10%	6%
Haryana	194	65.20%	14.47%	17.55%	2.83%
Andhra Pradesh	112	6%	24.60%	60.60%	7.30%
Karnataka	80	22.50	34.30%	20.60%	4%

2. Farmers' socio-economic profile:

The socio-economic factors furnish a base for further planning and development of the agriculture sector. The standard of living of people depends upon their socio-economic status. The socioeconomic status of farmers can be assessed or quantified through various parameters like age-wise distribution of farmers, their educational status, their size of land holdings, their farming experience etc. Table A4.3 presents a brief overview of the demographic profile of the respondents. It can be clearly seen from the statistics that there are wide variations in the socio-economic profile of the households across the sample states. At the aggregate, 1028 farmers were chosen from the selected seven states in India.

Table A4.3: Demographic profile of the respondents (% of households) – participants

States / Characteristics		Rajasthan	Maharashtra	Madhya Pradesh	Uttar Pradesh	Haryana	Andhra Pradesh	Karnataka	Aggregate
No of sample (Households)		130	310	111	91	194	112	80	1028
Household size (numbers)		5.57	5.32	6.23	5.53	4.91	4.72	6.01	5.47
Average number of earners in the HH		2.68	2.3	3.02	2.52	2.28	1.98	5.69	2.92
Farming experience of the respondents (years)		25.6	22.45	29.58	26.01	25.8	21.3	26.87	25.37
Age group	<16	0	0	0	0	0	0	0	0.00
	16-60	88.3	91.84	89.98	86.56	90.56	89.56	86.56	89.05
	>60	11.7	8.16	10.02	13.21	9.44	10.44	13.44	10.92
Education status (Above only)	Illiterate	4.1	10.56	5.39	2.00	20.60	22.56	10.63	10.83
	Up to primary	17.45	42.44	38.56	24.00	14.56	18.23	26.07	25.90
	up to secondary	55.85	29.00	45.23	56.32	36.56	46.54	44.92	44.92
	up to graduate	1.1	12.50	3.29	15.12	26.56	12.32	11.85	11.82
	above graduate	21.5	5.50	7.53	2.56	1.72	0.35	6.53	6.53

States / Characteristics		Rajasthan	Maharashtra	Madhya Pradesh	Uttar Pradesh	Haryana	Andhra Pradesh	Karnataka	Aggregate
Main occupation	Farming	95.6	100	98.25	99.56	96.85	98.23	97.36	97.98
	Self-business	4.12	0	1.2	0	2.56	1.2	2.64	1.67
	Salaried/ pensioners	0.2	0	0.23	0.43	0.23	0	0	0.16
	wage earners	0	0	0.32	0.01	0.36	0	0	0.10
	Others	0.08	0	0	0	0	0	0	0.01

The average household size was around five members, with an average number of three earning members. The household size was smallest in Andhra Pradesh, 4.91, while it was highest, 6.23, in Madhya Pradesh. The average farming experience of the sampled farmer respondents was around 25 years, with the highest at 29 years in Madhya Pradesh and the lowest at 22 years in Maharashtra. Looking at the education status among the selected households, the proportion of illiterate was around 10 %. Those who were educated up to primary level were found to be 26 %. The proportion of farmers educated up to secondary level was the highest at 45 % while graduates and above graduates were respectively, 12 % and 6 %. Around 89 % of the selected farmers were the working age of sixteen to sixty years, while only 10 % had senior citizen status above 60 years.

Glancing at the main occupation of the farmer respondents, it is evident that farming alone was the main occupation among the respondents for around 98 % of all states on aggregate. Salaried and pensioners contributed around 0.16 % of all the respondents, and respondents with self-business accounted for just 2 %.

3. Holding Size:

The details of the respondents' average size of land holdings are given in Table A4.4. It is discernible from the table that the average owned area of the sampled respondents of selected states was 8.6 acres. Maharashtra, Haryana and Karnataka had comparatively higher owned areas than other states. On aggregate, the net operated area was slightly higher (8.8 acres) than the owned area, indicating net lease-in exceeding the net lease-out area by the selected households.

The operated area was less than the owned area in Karnataka, Maharashtra and Uttar Pradesh, indicating either some owned areas not under the operation or the leased-out area being more than the leased-in area in these three states. The operated area was higher in Haryana, Madhya Pradesh, Rajasthan, and Andhra Pradesh.

Table A4.4: Average size of land holdings of the respondents (in acres)

States	Owned area	Net operated area	Gross cropped area	Cropping intensity (%)	Area irrigated (%)
Rajasthan	6.1	6.3	12.8	135.9	65.2
Maharashtra	10.6	7.6	10.4	136.8	77.9
Madhya Pradesh	7.1	7.3	9.7	131.3	81.7
Uttar Pradesh	6.9	6.4	8.1	130.2	93.1
Haryana	11.9	12.3	21.0	154.2	94.2
Andhra Pradesh	6.4	12.4	13.5	119.2	81.2
Karnataka	11.2	9.3	16.2	135.3	71.6
Aggregate	8.6	8.8	13.1	134.7	80.7

4. Seed Purchase Details:

Seed purchase is an essential part of agriculture. Farmers need to purchase high-quality seeds to produce a good crop. The seed market is a complex one, with many different factors to consider when making a purchase. One of the most important factors to consider is the type of seed. Many different types of seeds are available, each with its advantages and disadvantages. Some farmers prefer to purchase certified seed, which is a seed that has been tested and certified to meet specific standards. Other farmers prefer to purchase hybrid seed, a cross between two different varieties of plants. Hybrid seed often produces higher yields than certified seed but is also more expensive. The quality of the seed is important because it can affect the germination rate, the vigour of the seedlings, and the overall yield of the crop. Farmers should purchase seed from a reputable supplier and inspect the seed for signs of damage or disease before planting (Figure A4.2). Seed prices can vary widely, depending on the type of seed, the quality of the seed, and the supplier. Farmers should compare prices from different suppliers to get the best deal. Some types of seeds are more readily available than others. Farmers should make sure that they can purchase the type of seed they need in the quantity they need before planting season begins.

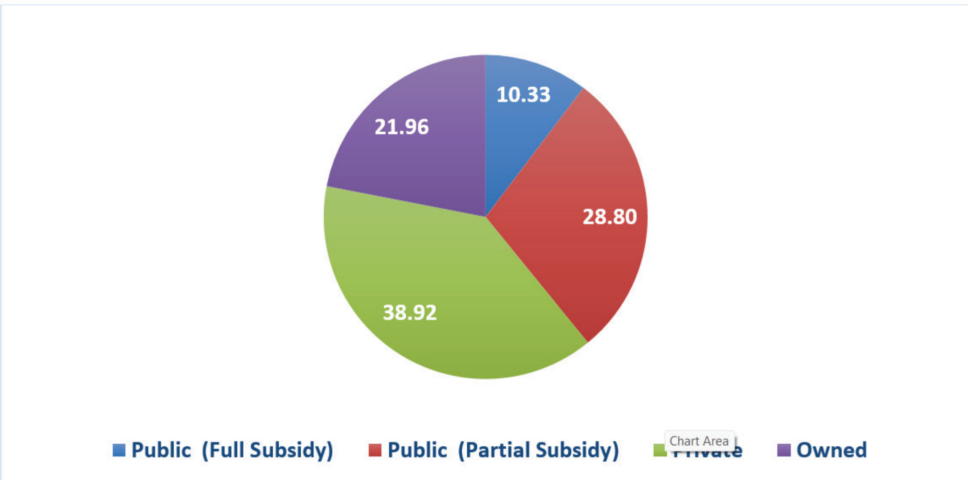


Figure A4.2: Source of Seeds (%)

Madhya Pradesh has the highest purchases under full subsidy, which is 30%, followed by Uttar Pradesh. Andhra Pradesh has the highest purchases under partial subsidy, which is 68%, followed by Karnataka (Table A4.5).

Table A4.5: Seed purchase details

State	Public		Private	Owned
	On Full Subsidy	On Partial Subsidy		
Rajasthan	6.4	23.4	51.1	19.1
Maharashtra	0.9	6.4	37.6	55.1
Madhya Pradesh	30.1	28.8	35.6	5.5
Uttar Pradesh	23.7	12.4	26.8	37.1
Haryana	2.2	13.3	75.6	8.9
Andhra Pradesh	0.0	69.0	6.9	24.1
Karnataka	9.0	48.3	38.9	3.8

5. Knowledge of MSP to the Farmers

The survey on oilseed cultivation in various states provided valuable insights into farmers' awareness and engagement with Minimum Support Price (MSP) policies. Among the 1028 surveyed farmers, a substantial 81.2% were found to be aware of the MSP provided by the government. This data underscores a notable gap in either the dissemination of information or the accessibility of such information among the farming community in the region.

6. Constraints faced by farmers in growing oilseeds

The opinion and suggestions of farmers regarding farmers regarding the cultivation of oilseeds in each state is presented in the Table 6 and are summarized below.

(i) 52.4% of the farmers agree that there is a lack of irrigation facilities in states like Rajasthan, Madhya Pradesh, Karnataka etc.

(ii) 50.1% of farmers from states like Maharashtra, Haryana etc. faced the problem of timely availability of seed.

(iii) 58% of the farmers, on average, disagree with the fact that there is an irregular & poor-quality supply of inputs.

(iv) 40.8% of the farmers agree that there are high mandi charges.

(v) Lack of awareness of improved oilseed technologies is a problem 61.1% of the farmers face.

(vi) 75.7% of the farmers agree that there is a lack of processing facilities in the states.

(vii). 82.2% of the farmers disagree with the fact that there is poor road infrastructure in the states.

Table A4.6: Constraints faced by farmers in growing oilseeds (%)

S. No.	Problems faced by the farmers		Rajasthan	Maharashtra	Madhya Pradesh	Uttar Pradesh	Haryana	Andhra Pradesh	Karnataka	Aggregate
Production Constraints										
1.	Non-availability of suitable varieties	Agree	11.0	28.0	15.0	16.0	30.0	50.0	12.0	23.1
		Disagree	4.0	15.0	35.0	32.0	6.7	31.0	32.0	22.2
		Don't Know	85.0	57.0	50.0	52.0	63.3	19.0	56.0	54.6
2.	Poor crop germination	Agree	8.2	15.0	12.0	25.3	21.1	41.0	15.0	19.6
		Disagree	51.2	48.3	23.5	34.3	17.8	38.0	40.0	36.1
		Don't Know	40.6	36.7	64.5	40.4	61.1	21.0	45.0	44.1
3.	Lack of irrigation facilities	Agree	85.2	75.2	65.3	32.6	19.2	29.3	60.2	52.4
		Disagree	12.3	14.3	12.6	16.3	45.2	13.2	22.8	19.5
		Don't Know	2.5	10.5	22.1	51.1	35.6	57.5	17.0	28.0
4.	Poor quality of soils	Agree	15.3	49.5	29.5	35.4	52.6	27.1	68.6	39.7
		Disagree	3.1	5.3	14.3	16.3	11.3	13.8	16.2	11.4
		Don't Know	81.6	45.2	56.2	48.3	36.1	59.1	15.2	48.8
5.	High input costs (diesel, fertilizer, agrochemicals etc.)	Agree	63.2	56.2	40.6	67.2	68.8	71.5	83.9	64.4
		Disagree	20.3	16.3	14.3	16.8	21.5	24.1	10.1	17.6
		Don't Know	16.5	27.5	45.1	16.0	9.7	4.4	6.0	17.8
6.	Problem of timely availability of seed	Agree	56.1	26.8	46.3	46.2	72.3	46.9	56.3	50.1
		Disagree	5.1	16.5	16.3	16.9	21.3	12.6	11.3	14.2
		Don't Know	38.8	56.7	37.4	36.9	6.4	40.5	32.4	35.5
7.	Irregular & poor-quality supply of inputs	Agree	5.1	6.3	16.2	21.3	13.3	29.3	11.3	14.6
		Disagree	56.2	60.3	67.2	52.9	70.5	43.6	55.9	58.0
		Don't Know	38.7	33.4	16.6	25.8	16.2	27.1	32.8	27.2
Marketing Constraints										
8.	High mandi charges	Agree	53.2	16.2	26.3	31.7	46.9	56.8	55.0	40.8
		Disagree	16.3	19.4	21.5	16.7	11.3	25.3	31.5	20.2
		Don't Know	30.5	64.4	52.2	51.6	41.8	17.9	13.5	38.8

S. No.	Problems faced by the farmers		Rajasthan	Maharashtra	Madhya Pradesh	Uttar Pradesh	Haryana	Andhra Pradesh	Karnataka	Aggregate
9.	Exploitation by market intermediaries	Agree	9.2	16.3	70.3	55.3	56.4	59.1	60.4	46.7
		Disagree	16.3	35.3	16.3	42.6	17.5	13.2	9.5	21.5
		Don't Know	74.5	48.4	13.4	2.3	26.1	27.7	30.1	31.7
10.	Low and fluctuating prices at the time of harvesting	Agree	70.6	75.3	80.2	77.6	63.5	71.2	85.2	74.8
		Disagree	5.6	6.0	8.1	12.3	11.9	19.4	12.3	10.8
		Don't Know	23.8	18.7	11.7	10.1	24.6	9.4	2.5	14.4
Information access										
11.	Lack of awareness of improved oilseed technologies	Agree	70.2	68.3	52.1	56.3	62.3	67.1	51.7	61.1
		Disagree	10.6	15.2	22.3	21.7	11.3	19.7	12.3	16.1
		Don't Know	19.2	16.5	25.6	22.0	26.4	13.2	36.0	22.7
12.	Poor extension services	Agree	23.6	39.1	32.6	15.2	22.1	16.7	25.2	24.9
		Disagree	51.3	53.2	16.5	46.3	41.3	61.2	59.7	47.0
		Don't Know	25.1	7.7	50.9	38.5	36.6	22.1	15.1	28
13.	Lack of information about prices and markets	Agree	42.1	43.0	47.3	63.1	18.9	25.0	19.3	36.9
		Disagree	16.3	19.0	42.3	33.1	13.5	35.3	45.0	29.2
		Don't Know	41.6	38.0	10.4	3.8	67.6	39.7	35.8	33.8
Infrastructural and Institutional constraints										
14.	Lack of institutional credits	Agree	23.1	31.3	52.3	54.6	41.6	61.4	44.3	44.0
		Disagree	46.2	52.3	41.3	16.5	31.6	36.2	41.2	37.9
		Don't Know	30.7	16.4	6.4	28.9	26.8	2.4	14.5	18.0
15.	Irregular supply of power	Agree	46.2	62.1	43.2	51.2	41.3	51.3	32.1	46.7
		Disagree	16.3	24.3	16.4	41.3	46.8	37.3	23.6	29.4
		Don't Know	37.5	13.6	40.4	7.5	11.9	11.4	44.3	23.8
16.	Poor marketing system and access to markets	Agree	2.0	42.1	0.0	0.0	11.1	68.2	66.4	27.1
		Disagree	1.0	57.3	0.0	0.0	1.1	31.8	34.2	17.9
		Don't Know	96.9	0.6	100.0	100.0	87.8	0.0	0.0	55.0

S. No.	Problems faced by the farmers		Rajasthan	Maharashtra	Madhya Pradesh	Uttar Pradesh	Haryana	Andhra Pradesh	Karnataka	Aggregate
17.	Lack of processing facilities in the area	Agree	71.2	73.5	85.2	69.1	73.6	76.1	81.3	75.7
		Disagree	13.2	19.5	12.3	12.3	14.2	9.3	11.2	13.1
		Don't Know	15.6	7.0	2.5	18.6	12.2	14.6	7.5	11.1
18.	Lack of appropriate transport means	Agree	15.3	23.2	31.3	41.2	14.3	45.3	22.7	27.6
		Disagree	42.6	51.3	34.9	45.3	54.2	54.3	42.9	46.5
		Don't Know	42.1	25.5	33.8	13.5	31.5	0.4	34.4	25.8
19.	Inadequate storage facilities	Agree	60.2	71.6	81.3	84.3	76.2	81.3	79.3	76.3
		Disagree	12.3	14.9	16.2	14.0	21.0	17.3	11.0	15.2
		Don't Know	27.5	13.5	2.5	1.7	2.8	1.4	9.7	8.4
20.	Poor road infrastructure	Agree	4.1	12.6	12.9	15.3	13.2	11.9	6.1	10.8
		Disagree	91.2	83.6	73.6	81.3	85.3	79.9	81.1	82.2
		Don't Know	4.7	3.8	13.5	3.4	1.5	8.2	12.8	6.8
21.	High transportation costs	Agree	36.4	46.1	52.3	19.3	64.1	51.4	36.4	43.7
		Disagree	16.2	21.3	22.2	34.6	19.4	25.1	26.7	23.6
		Don't Know	47.4	32.6	25.5	46.1	16.5	23.5	36.9	32.6
Natural constraints										
22.	Extreme variation in temperature	Agree	23.5	35.6	41.3	47.6	26.0	28.9	38.3	34.4
		Disagree	26.7	56.1	23.1	46.6	71.3	16.4	13.6	36.2
		Don't Know	49.8	8.3	35.6	5.8	2.7	54.7	48.1	29.2
23.	Excessive rains	Agree	16.3	26.1	6.7	31.2	12.3	19.1	16.4	18.3
		Disagree	19.4	16.2	24.3	36.1	42.6	41.2	16.4	28.0
		Don't Know	64.3	57.7	69.0	32.7	45.1	39.7	67.2	53.6

State wise gist of survey is given below.

a) Rajasthan:

1. Rajasthan farmers stress the importance of improved irrigation due to low and unpredictable rainfall. They suggest promotion of better irrigation systems, such as drip irrigation, to optimize water usage for oilseed cultivation.
2. Rajasthan farmers are troubled by crop damage caused by wildlife, especially blue bulls. They propose financial aid or community-led wildlife management projects to reduce losses and encourage oilseed farming.

3. To cope with short rainfall periods, Rajasthan farmers suggest early sowing and drought-resistant oilseed varieties to increase yield potential.
4. Farmers were worried about unpredictable weather and yield variability. They propose expanding crop insurance schemes to manage risks in oilseed farming, thereby promoting investment in the sector.
5. For mustard cultivation, farmers suggest stabilizing prices through awareness of future trading and strengthening crop insurance by calculating indemnity losses at the village level.
6. Farmers suggest that strengthening extension services is crucial for disseminating new technologies, best practices, and crop management techniques to fellow farmers. By improving the reach and effectiveness of extension services, farmers can stay updated on the latest advancements in agriculture, enabling them to enhance productivity and profitability.
7. Most of the farmers, i.e. 85.2%, agreed that there is lakhs of irrigation facilities in Rajasthan.

b) Maharashtra:

1. Farmers in Maharashtra report that weather-related factors, particularly drought, significantly affect soybean yield in the state. Over the past five years, approximately 91% of farmers have been impacted by drought. The frequent occurrence of drought reduces oilseed yield, resulting in lower output and diminished profits for farmers.
2. Farmers suggest establishing and strengthening early warning systems for pest and disease outbreaks. Prompt actions based on early warnings can help minimize the need for costly pesticide applications and mitigate environmental impacts associated with pest and disease control measures.
3. There is the problem of low and fluctuating prices at the time of harvesting in Maharashtra, to which 75.3% of the farmers agreed.

c) Madhya Pradesh:

1. Farmers emphasize the need for machinery designed explicitly for soybean cultivation, such as seed cum fertilizer drills, ridge and furrow implements, harvesters, and combiners. Existing machinery tailored for wheat isn't optimal for soybean farming.
2. Farmers demand regular electricity supply, proper storage facilities at the village level, strengthening of extension and market intelligence services, and the establishment of more regulated market/purchase centers.
3. Farmers suggest promoting the development and adoption of oilseed varieties resistant to waterlogging and diseases associated with excessive rainfall.
4. In Madhya Pradesh, 70.3% of farmers agreed that there is exploitation in the market by intermediaries.

d) Uttar Pradesh:

1. More than half of linseed farmers delay their sowing due to late harvesting of previous Kharif crops, particularly paddy.

2. Farmers opinion that about 50% of them experience lower yields in linseed compared to other crops. Moreover, the growth pattern of these crops in Uttar Pradesh has been riskier because of the rainfall pattern and limited water resources.
3. 84.3% of farmers in Uttar Pradesh agreed that there are no proper storage facilities in the state at local level.

e) Haryana:

1. The rice-wheat cropping system, covering 58% of the cultivated area in Haryana, is now recognized as a significant cause of soil health deterioration. To promote diversification in these areas, research on crops such as maize, soybean, castor, sunflower, groundnut, rapeseed-mustard, autumn sugarcane, gram, arhar, and moong bean must be strengthened. Haryana has a high potential for oilseed production, which needs to be harnessed.
2. Farmers suggest providing targeted subsidies on diesel, fertilizers, and agrochemicals to ease their financial burden. Additionally, they recommend facilitating easy and affordable access to credit for farmers to purchase inputs.
3. In Haryana, 73.6% of farmers face a lack of processing facilities.

f) Andhra Pradesh:

1. Most surveyed farmers suggested that the government should supply suitable, good-quality seeds, fertilizers, and pesticides at subsidized prices.
2. Farmers also emphasized the importance of a regular power supply, at least 10 hours daily, for better oilseed production.
3. Farmers suggested expanding irrigation facilities through subsidized bore wells.
4. Farmers suggested the establishment of processing facilities in nearby areas to generate employment in rural areas and reduce the influence of intermediaries and village traders.
5. Some farmers emphasized the need for soil testing laboratories at the mandal level to promote soil test-based fertilizer recommendations.
6. Farmers suggest the enhancement of Minimum Support Prices (MSP) annually according to input market prices.
7. Farmers suggest extending government agencies to purchase oilseeds at the village level to control traders and intermediaries.
8. Farmers propose to introduce weather-based insurance policies and expanding regular markets while establishing processing units nearby.
9. Farmers express the need for farm-level testing laboratories for soil, seeds, land types, and insecticides/pesticides.
10. Farmers emphasize the need to ensure a remunerative price by procuring groundnut from them if prices fall below the minimum support price. They also advocate for promoting soil test-based fertilizer recommendations and the application of gypsum in irrigated groundnut crops to meet calcium and sulphur requirements.

11. For sunflower cultivation, farmers emphasize the need to supply quality seeds of improved varieties and hybrids to enhance productivity. They suggest that the government provide Boron Nutrition at subsidized prices to farmers during the floret opening stage to increase seed set and yield.
12. Farmers suggest that the central government impose duties on imported palm oil to support local cultivators.
13. 68.2% of farmers in Andhra Pradesh agreed to the fact that there is a problem of poor marketing systems and access to markets.

g) Karnataka:

1. Farmers suggest that developing entrepreneurial activities is essential to safeguard oilseed growers.
2. Many small and marginal farmers lack access to oilseed markets and often sell their produce at lower rates. These farmers are typically illiterate and economically disadvantaged, making them hesitant to retain oilseeds for long periods. By developing entrepreneurial skills among these growers, they can secure remunerative prices for their crops, thereby increasing oilseed production and productivity in the years to come.
3. High input costs (diesel, fertilizer, agrochemicals, etc.) have bothered about 83.9% of farmers in Karnataka.

State-wise Quadrant Strategy for Primary and Secondary Edible Oil Crops

ANNEXURE- 5

Soybean

Soybean		Yield (National Average: 1.03 t/ha)	
		High	Low
Area (National Average: 0. 55 Mha)	High	Maharashtra	Madhya Pradesh, Rajasthan
	Low	Karnataka, Telangana, Gujarat, Nagaland, Uttarakhand, Arunachal Pradesh, Meghalaya, Andhra Pradesh, Mizoram, Himachal Pradesh	West Bengal, Tripura, Sikkim, Jharkhand, Manipur, Bihar, Chhattisgarh, Uttar Pradesh

Safflower

Safflower		Yield (National Average: 0.70 t/ha)	
		High	Low
Area (National Average: 0. 005 Mha)	High	Karnataka	Maharashtra
	Low	Telangana, Madhya Pradesh, Arunachal Pradesh, West Bengal, Bihar	Jharkhand, Andhra Pradesh, Odisha, Chhattisgarh

Mustard

Mustard		Yield (National Average: 1.45 t/ha)	
		High	Low
Area (National Average: 0.24 Mha)	High	Rajasthan, Madhya Pradesh., Haryana	Uttar Pradesh., West Bengal, Jharkhand, Assam
	Low	Gujarat, Punjab, Telangana	Bihar, Jammu Kashmir., Chhattisgarh, Manipur, Arunachal Pradesh, Nagaland, Uttarakhand., Maharashtra, Meghalaya, Odisha, Himachal Pradesh, Tripura, Delhi, Sikkim, Andhra Pradesh, Karnataka, Mizoram, Tamil Nadu

Groundnut

Groundnut		Yield (National Average: 1.77 t/ha)	
		High	Low
Area (National Average: 0.20 Mha)	High	Gujarat, Rajasthan, Tamil Nadu	Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra
	Low	Telangana, west Bengal, Punjab, Goa, Puducherry	Uttar Pradesh, Odisha, Chhattisgarh, Jharkhand, Haryana, Tripura, Manipur, Uttarakhand, Nagaland, Arunachal Pradesh, Bihar, Kerala, Himachal Pradesh

Sesamum

Sesamum		Yield (National Average: 0.52 t/ha	
		High	Low
Area (National Average: 0.05 Mha)	High	West Bengal, Gujarat	Madhya Pradesh, Uttar Pradesh, Rajasthan
	Low	Tamil Nadu, Karnataka, Telangana, Assam, Tripura, Nagaland, Meghalaya, Arunachal Pradesh, Haryana, Bihar, Mizoram, Puducherry	Andhra Pradesh, Maharashtra, Chhattisgarh, Odisha, Jharkhand, Jammu & Kashmir, Punjab, Uttarakhand, Himachal Pradesh, Kerala, Dadra and Nagar Haveli

Sunflower

Sunflower		Yield (National Average: 0.88 t/ha)	
		High	Low
Area (National Average : 0. 014 Mha)	High	Odisha	Karnataka, Maharashtra
	Low	Haryana, Telangana, Bihar, West Bengal, Punjab, Uttar Pradesh., Gujarat, Madhya Pradesh. Rajasthan	Andhra Pradesh, Tamil Nadu., Nagaland, Arunachal Pradesh, Jharkhand, Chhattisgarh

Nigerseed

Nigerseed		Yield (National Average: 0.31 t/ha)	
		High	Low
Area (National Average: 0.012 Mha)	High	Odisha, Madhya Pradesh	Chhattisgarh
	Low	Assam, Andhra Pradesh, Jharkhand, Gujarat, West Bengal	Maharashtra, Karnataka

Linseed

Linseed		Yield (National Avg.: 0.60 t/ha)	
		High	Low
Area (National Average: 0.012 Mha)	High	Madhya Pradesh, Uttar Pradesh	Jharkhand, Chhattisgarh
	Low	Bihar, Rajasthan, Nagaland, Assam, Jammu and Kashmir, Arunachal Pradesh	Odisha, Maharashtra, West Bengal, Karnataka, Himachal Pradesh., Meghalaya, Tripura

Rice

Rice		Yield (National Avg.: 2.69 t/ha)	
		High	Low
Area (National Average: 2.55 Mha)	High	Punjab, Andhra Pradesh, Tamil Nadu, Telangana, Haryana, West Bengal	Uttar Pradesh, Bihar, Madhya Pradesh, Assam, Jharkhand, Odisha, Maharashtra, Chhattisgarh
	Low	Chandigarh, Karnataka, Tripura, Puducherry, Delhi, Kerala	Meghalaya, Andaman and Nicobar Islands, Rajasthan, Manipur, Gujarat, Dadra and Nagar haveli, Jammu and Kashmir, Himachal Pradesh, Sikkim, Arunachal Pradesh, Mizoram, Daman and Diu, Nagaland

Coconut

Coconut		Yield (National Average: 9665 nuts/ha)	
		High	Low
Area (National Average: 0. 28 Mha)	High	Tamil Nadu	Kerala, Karnataka
	Low	West Bengal, Andhra Pradesh	Tripura, Bihar, Chhattisgarh, Nagaland, Assam, Gujarat, Maharashtra, Odisha

Cotton

Cotton		Yield (National Average: 0.43 t/ha)	
		High	Low
Area (National Avg.: 1.12 M ha)	High	Gujarat, Rajasthan, Andhra Pradesh	Maharashtra, Telangana, Haryana, Karnataka, Madhya Pradesh
	Low	Punjab, Kerala, Jammu and Kashmir, Odisha	West Bengal, Tamil Nadu, Meghalaya, Chhattisgarh, Puducherry, Uttar Pradesh, Nagaland, Tripura, Mizoram, Assam

Castor

Castor		Yield (National Average: 1.81 t/ha)	
		High	Low
Area (National Avg.: 0. 05 M ha)	High	Gujarat	Rajasthan
	Low	Nil	Andhra Pradesh, Telangana, Maharashtra, Odisha, Tamil Nadu, Madhya Pradesh, Karnataka, Haryana, Assam, Nagaland, Arunachal Pradesh, Bihar, Jharkhand Meghalaya, West Bengal

Targeted Crop Strategies with Institutional Support and Technologies

ANNEXURE- 6

i) Soybean

Intervention	Impact	Pre-requisite
Broad Bed and Furrow (BBF) method of sowing	Enables increasing the income through farm-level productivity gains of at least 20-25 %.	Provision of BBF equipment on custom hiring basis; Awareness by State Department / ATMA
Provision of quality seed	Ensures increasing the income by 15-20 % due to higher seed replacement with the latest varieties suiting the given agro-ecological conditions.	Seed rolling plan through institutional arrangements (region / state based seed hubs/seed villages)
Optimum Seed rate	The seed rate on the farmers' fields is high and hovers around 75-85 kg/ha as against the recommended seed rate at 65 kg/ha. Farm level costs can be reduced by 10-15%.	Demonstrations; Awareness by State Department / ATMA
Seed inoculation and seed treatment	Seed inoculation with 500 g per 65 kg seed. Bradyrhizobium japonicum culture + PSB @ 500 g per 65 kg seed ensures cost reduction by increased N fixation and P availability. Seed treatment with Trichoderma ensures protection against soil-borne diseases and ensures a 10 % increase in income.	Ensure availability through Bio control labs; method demonstrations
Intercropping	Intercropping with pigeon peas enables higher income and also mitigates the risk of crop failure.	Demonstrations; Awareness by State Department / ATMA
Weed Management	Weed management through herbicides increases the income by 20-25 %.	Method demonstrations; Awareness by State Department / ATMA
Need-based plant protection	Need-based plant protection applications can ensure a 25 % increase in income after factoring out the cost towards plant protection.	Cluster-based Demonstrations

Intervention	Impact	Pre-requisite
Lifesaving irrigation	Lifesaving irrigations at the flowering and pod formation stage can increase the income by 15 %.	Micro irrigation (sprinklers)
Other intervention	Creating value chains on a cluster basis in the Malwa region through skill/ entrepreneurship development for protein-based food products and fortification can provide additional income and increased employment generation.	

ii) Groundnut

Intervention	Impact	Pre-requisite
Broad Based Furrow (BBF) method of sowing	Enables increasing the income through farm-level productivity gains of at least 20%, especially in drought-prone areas of the country. The BBF technology facilitates drainage facilities during periods of excess rains and acts as a soil moisture measure during dry spells.	Provision of BBF equipment on a custom hiring basis
Provision of quality seed	Ensures increasing the income by 20-25 % due to higher seed replacement with the latest varieties suiting the given agroecological conditions.	Seed rolling plan through institutional arrangements (region /state-based seed hubs). Early maturing Spanish varieties seed varieties are to be given emphasis, especially in drought-prone areas of Andhra Pradesh, to combat the changing trends in the LGP.
Reduce seed rate	Farm-level grading of the small and high-quality kernels for sowing purposes can reduce the cost by 10-15%.	Awareness by State Department / ATMA.
Seed inoculation and seed treatment	Seed inoculation with *Rhizobium* can stimulate N fixation and reduce the Inorganic fertilizer requirement in the long run. Seed treatment with Captan, Thiram (3 g/ kg of the kernel) and Trichoderma (10 g/ kg of the kernel), deep ploughing and soil application of neem /castor cake (500 kg/ ha) is recommended to control stem rot.	Ensure availability of quality bioagents/inoculants through Bio control labs.
Inter cropping	Inter cropping with castor / redgram in the districts of Anantapuram and Kurnool (A.P); Chitradurga, Tumkur, and Bellary (KA) can result to increased income by 15-20 % considering the shifts in the LGP evidenced in the above districts during the last decade.	Large scale demonstrations/ Awareness by State Department / ATMA.

Intervention	Impact	Pre-requisite
Inorganic fertilisers	Replace DAP with SSP. It ensures cost reduction at the farm level. Apply Gypsum @ 500 kg / ha once in two years. Enables for better pod formation coupled higher oil content thereby resulting to higher output price. The cumulative effect on the income could be 15-20 % due to the above interventions	Soil testing facility and recommendation/ ensuring supply of inputs
Secondary and Micro nutrients	Application of Zinc Sulphate: Soil application in furrows @ 10-20 kg/ha in Andhra Pradesh, Bihar, Haryana, Karnataka, Madhya Pradesh and Uttar Pradesh Borax: Soil application in furrows @ 5-10 kg/ha Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh and Tamil Nadu. Iron: Foliar application of 0.15% ferrous sulphate + 0.15% citric acid in Gujarat, Karnataka, Tamil Nadu and Maharashtra The secondary and micro nutrients can enhance the net income by 10-15%.	Soil testing facility and recommendation/ ensuring supply of inputs
Irrigation	Irrigations at critical stages (2-3) can enhance the yield and income by 25-35 %.	Infrastructure for Micro irrigation/ sprinkler
Need-based plant protection	Spraying of neem seed extract @ 5% or crude neem oil in teepol @2% against foliar fungal diseases and sucking insect pests and Spodoptera. Seed treatment with Trichoderma harzianum @ 4g/kg seed against soil-borne pathogens or soil application of Trichoderma sp. as per local recommendation (or 25 kg/ha). Soil application of phorate granules 10 G @ 25 kg/ha or carbofuran 3 G @ 10 kg/ha against white grub and termites. Use of pheromone traps @ 10 /ha and Spray of Spodoptera NPV @ 250 LE/ha or Bacillus thuringiensis @ 1.5 kg/ha. Digging of drenches around the fields to avoid the dispersal of larvae of red hairy caterpillars. Spraying of crude neem oil in tempol @ 2% or chlorpyrifos EC 0.05% or dimethoate EC 0.03% for controlling leaf miner. Spray of Helicoverpa NPV @ 250 LE/ha or Bacillus thuringiensis @ 1.5 kg/ha for controlling Helicoverpa Ensure the availability of biopesticides through Bio control labs.	

Intervention	Impact	Pre-requisite
Other intervention	**Gujarat**: Emphasis on HPS Groundnut for exports/cluster approach in the districts of Kutch, Jamnagar, Bhavnagar, Junagadh and Vadodara. The income enhancement envisaged is 30-40%. **Telangana:** Cluster-based seed production hubs in Mahbubnagar, Karimnagar, Nalgonda, Rangareddy, and Warangal can ensure an enhanced income of 25 %. It also stimulates local employment opportunities. **Andhra Pradesh**: Bold-seeded varieties for table purposes in YSR Kadapa, Chittoor district, can enhance the farm income by 25%. **Rajasthan:** Focus on Bold seeded varieties for export/table purposes. The income increase at the farm level could be 25-30 %. Processing of edible oils on cluster approach can enhance income by 25-30%. Explore the creation of CIG / FPOs/SHG/ for the promotion of pressed oils.	

iii) Rapeseed-Mustard

Intervention	Impact	Pre-requisite
Furrow Irrigated Raised Bed	Enables increasing the income through farm level productivity gains of 10% and saves 30% water requirement.	Provision of equipment on a custom hiring basis
Tillage operations	Minimal tillage operations (3-4) as against the conventional (6-8) ensure improving soil health with no economic loss. Cost towards labour is reduced by 10%.	Awareness through Developmental agencies / ATMA
Provision of quality seed	Ensures increasing the income by 15-20 % due to higher seed replacement with suitable varieties suiting the given agroecological conditions. A special seed production programme is to be developed for UP to increase coverage under the recommended varieties. Explore massive seed production for varieties with low erucic acid to ensure a higher premium price (10-15 %) over the traditional varieties.	Seed rolling plan through institutional arrangements

Intervention	Impact	Pre-requisite
Higher seed rate	Adopt higher seed rate and spacing (45x15) in limited rainfall/moisture regions. The income increase would be approximately 10-15%.	Awareness through Developmental agencies / ATMA
Seed inoculation and seed treatment	Seed dressing with Azotobacter enhances seed yield by 15-20% besides saving 25 kg N/ha, adding to net income by 10-15%. Seed treatment with PSB increases the income by 25% through increased productivity of 30%. Seed treatment with Trichoderma @5g/ kg of seed enables control of Sclerotinia and Alternaria, providing 10% additional net income at the farm level.	Ensure availability through Bio control labs; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Need-based plant protection.	Seed treatment with Carbendazim @ 2.0 gm/kg seed in Sclerotinia-affected areas and with Apron 35 SD @ 6g/kg in the white rust-affected areas enhance the net income by 10-15%.	Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Inorganic fertilisers	Replace DAP with SSP. It ensures cost reduction at the farm level. Apply Gypsum @ 500 kg/ha once in two years. Enables for better seed set coupled with higher oil content, thereby resulting in higher output price. The cumulative effect on the income could be 15-20 % due to the above interventions.	Soil testing facility and recommendation / Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Intercropping	Intercropping with chickpea (1:4), lentil (1:5), and wheat (1:9) for increased income of 10-15%.	Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Irrigation	Irrigation through sprinkler/drip enhances the net income by 20-25 % and reduces irrigation water requirement by 50%, besides lowering the requirement of nitrogen fertilizer by 25%.	Infrastructure for drip/ sprinkler systems; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination

Intervention	Impact	Pre-requisite
Secondary and micronutrients	Basal application of 40 kg S/ha through gypsum or elemental sulphur to the mustard crop increases the net income by 15-20 % through increased oil content (2%) and productivity by 20- 25%. Basal application of 5 kg Zn/ha to mustard crops improves the yield and income by 10-12 %. Application of Boron as a basal dose of 1 kg/ha or 2 foliar sprays of 0.25% boric acid at 40 and 60 days after sowing increases mustard seed yield by 20% with net economic gains of 15%. Soil testing facility and recommendation / Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination	
Rapeseed-Mustard	Explore possibilities of creation/ involvement of FPOs in Rajasthan, Madhya Pradesh, and Maharashtra for value addition. This can enhance the income by 25%.	

iv) Sesame

Intervention	Impact	Pre-requisite
Method of sowing	Line sowing; sowing through seed drill with attachment for line sowing can enable enhanced productivity through optimum plant population besides facilitating intercultural operations. The income can be enhanced by 15-20%.	Provision of equipment on a custom hiring basis; seed pelleting
Tillage operations	Ensuring fine tilth with weed-free / levelled conditions for better plant stand can enhance income by 15 %.	Awareness through Developmental agencies / ATMA/ Custom hiring facility for rotavator
Provision of quality seed	Ensures increasing the income by 20-25 % due to higher seed replacement with suitable varieties suiting the given agroecological conditions. A special seed production programme is to be developed for Bundelkhand to increase coverage under the recommended varieties for realizing a higher income of 15-25%.	Seed rolling plan through institutional arrangements (region /state-based seed hubs/seed village/ demonstrations)
Intercultural	Two weeding at 15-20 days and at 35-40 days enhances income by 20%.	Awareness through ATMA; Use of ICT for technology dissemination
Gypsum application	The application of gypsum enhances the net income by 15 %.	Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination

Intervention	Impact	Pre-requisite
Seed inoculation and seed treatment	Seed dressing with Azotobacter enhances seed yield by 15-20% besides saving 25 kg N/ha, adding to net income by 10-15%. Seed treatment with PSB increases the income by 25% through increased productivity of 30%. Seed treatment with Trichoderma @5g/ kg of seed enables control of seed-borne diseases, providing 10% additional net income at the farm level. Seed treatment with Thiram/ captan @3g /kg of seed. An income increase of 15-20 % is attainable through the seed inoculation/ treatment	Ensure availability through Bio control labs; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Intercropping	Proven intercropping technology with groundnut, soybean, green gram, black gram, and pigeon pea has been evidenced to enhance the net returns by 20-25%. This needs large-scale replication in Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, and West Bengal.	Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Need-based plant protection.	Need-based plant protection to control leaf roller and capsule borer, gall fly, blight, stem and root rot; leaf spots can result in an additional net income of 20-25%.	Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Other intervention	Emphasis on bold-seeded sesame in select agro-eco regions of Gujarat, Madhya Pradesh, Rajasthan, Telangana, and Karnataka for export purposes. Identify niche areas for Organic sesame in niche areas of the country (NEH) Promotion of processing of sesame oil as a level industry through SHG/ entrepreneurship/FPOs.	

v) Sunflower

Intervention	Impact	Pre-requisite
Optimum spacing and thinning	Sowing with spacing of 60cm x 30 cm can increase income of 15%.	Demonstrations / Awareness through Developmental agencies / ATMA

Intervention	Impact	Pre-requisite
Provision of quality seed	Saturating the area with the most promising hybrids can ensure increased income due to the cumulative effect of increased yield and higher oil content.	Seed rolling plan through institutional arrangements
Seed Hardening	Reduced seed rate, ensures better germination for optimum plant stand resulting to 20% increase in farm level income through productivity enhancement.	Demonstrations / Awareness through Developmental agencies / ATMA
Seed inoculation and seed treatment	Seed dressing with Azatobacter + Azospirillum increases yield by 15-20% besides saving of 25 kg N/ha adding to net income by 10-15%. Seed treatment with PSB increases the income by 25% through increased productivity of 30%. Seed treatment with Trichoderma @5g/kg of seed enables control of seed borne diseases providing 10% additional net income at the farm level.	Ensure availability through Bio control labs; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Application of Borax	Foliar application of boron (Borax 0.2%) at the ray floret opening stage fosters higher seed set and results in increasing the net income by 10-15%.	Demonstrations ; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Intercropping	Inter cropping for the recommended agro ecological situations can lead to income increase by 15-20%. (Sunflower + Groundnut; Sunflower + Pigeon pea; Sunflower + Sorghum)	Demonstrations ; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Soil-based INM	Improves seed yield and oil content and enhances the income by 20-25%. Ensures cost reduction in the long run with respect to fertiliser usage	Ensure availability of Soil testing facility, SSP, Sulphur, Boron, and Zinc; Large scale cluster-oriented demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Need-based plant protection.	Seed treatment with Metalyxyl @ 6g/kg against downy mildew; Imidacloprid @ 6g/kg against sucking pests for SND; Prophylactic spray of bavistin for Alternaria, wettable sulphur for Powdery mildew, can add to the net income by 15-20%.	Demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination

Intervention	Impact	Pre-requisite
Need-based irrigation	Need-based irrigations (2-4) enables an increase in yield and thereby on income by 25-30% Demonstrations: Micro irrigation facility and support for sprinkler and drip; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.	
Other intervention	The finely chopped thalamus, rich in fibre and crude protein, when used as a feed ration for the milch animals, enhances the fat content, thereby adding to the higher price realization of milk. Apiary (2-3 units) per ha enables additional income by 15-20%.	

vi) Safflower

Intervention	Impact	Pre-requisite
Optimum spacing	Sowing with the geometry of 45cm x 30cm and thinning to maintain the spacing can lead to increasing the income by 20%.	Demonstrations; Awareness through Developmental agencies / ATMA
Provision of quality seed	The improved varieties should be multiplied on a massive scale to ensure them finding a place in the farmers' fields. The increase in net income could be as high as 20-25 % by the spread of the recommended genotypes.	Seed rolling plan through institutional arrangements (region /state based seed hubs, seed village)
Seed inoculation and seed treatment	Seed treatment with Trichoderma @8-10g/kg of seed and with Thiram / Carbendazim @3g/kg seed enables control of seed borne diseases providing 15-20% additional net income at the farm level. Application of Azotobacter/ Azospirillum 25g/kg seed enhances the nutrient availability. Seed treatment with PSB increases the income by 25% through increased productivity of 15%.	Ensure availability through Bio control labs; Large scale Demonstrations on cluster approach; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Provision of quality seed	Promote recommended cultivars matching LGP and the eco system under which it is grown.	Seed rolling plan through institutional arrangements

Intervention	Impact	Pre-requisite
Seed inoculation and seed treatment	Seed treatment with Azatobactor, Trichoderma and PSB enhances the income by 20%. Seed soaking before sowing enables better germination and plant stand ultimately resulting to 15% income enhancement.	Ensure availability through Bio control labs; Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Inter cropping	Intercropping with the region recommended crops can result to 15-20% additional net income.	Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Integrated Nutrient Management	Balanced nutrient management enables to increase the income by 20% besides reducing the cost in the long run.	Soil testing facility and recommendations; Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Need based plant protection	Integrated pest management for control of wilt, blight, powdery mildew, rust and bud fly can increase the yield by 20%.	Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Machinery for harvesting and Threshing	Facilitating harvesting and threshing with combine harvesters reduces the cost of drudgery of labour and the income enhancement could be 15-20%.	Provision of combine harvesting on custom hiring basis; Large scale Demonstrations on cluster approach; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Other intervention	Explore possibilities of creation of FPO's in Maharashtra, Karnataka, Telangana for value addition through filtered oils which have high nutritious value due to the presence of Vitamin E and alpha tocopherols, phenols. This can enhance the income by 25-35%. The deoiled seed has high vintage value for the Vitamin E, fibre, protein, alpha tocopherols that have a positive effect on the small ruminants and cattle. Safflower petals: Explore for value addition of petals in select agro ecological regions.	

vii) Linseed

Intervention	Impact	Pre-requisite
Provision of quality seed	Promote recommended cultivars matching LGP and the eco system under which it is grown	Seed rolling plan through institutional arrangements
Seed inoculation and seed treatment	Seed treatment with Azatobactor, Trichoderma and PSB enhances the income by 20%. Seed soaking before sowing enables better germination and plant stand ultimately resulting to 15% income enhancement.	Ensure availability through Bio control labs; Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Inter cropping	Intercropping with the region recommended crops can result to 15-20% additional net income.	Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Integrated Nutrient Management	Balanced nutrient management enables to increase the income by 20% besides reducing the cost in the long run.	Soil testing facility and recommendations; Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Need based plant protection	Integrated pest management for control of wilt, blight, powdery mildew, rust and bud fly can increase the yield by 20%.	Large scale demonstrations; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Other intervention	Value addition for retting and scotching of linseed fibre through creation of FPO's can help in augmenting the income by 20%. Creation of small-scale women driven entrepreneurs / SHG's for utilizing the omega 3 rich seed / oil This can enable for increased income of 20-25%.	

viii) Nigerseed

Intervention	Impact	Pre-requisite
Provision of quality seed	Promote recommended cultivars matching the LGP and the eco system under which it is grown	Seed rolling plan through institutional arrangements (region /state based seed hubs)

Intervention	Impact	Pre-requisite
Seed inoculation and seed treatment	Seed treatment with 10 g/kg Azatobactor, 8 g/kg Trichoderma and 10 g/kg PSB enhances the income by 20%.	Ensure availability through Bio control labs; Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination.
Inter cropping	Intercropping with the region recommended crops can result to 15-20% additional net income.	Awareness through Developmental agencies / ATMA; Use of ICT for technology dissemination
Mixed cropping	Ensuring Seed treatment with 10 g/kg Azatobactor, 8 g/kg Trichoderma and 10 g/kg PSB for the pulses and millets in Eastern Ghat Highland Zone alongwith niger enhances improved system productivity thereby resulting to income increase by 30%.	
Need based plant protection	Integrated pest management for control of caterpillar, cutworm, aphids, semilooper, capsule fly. Leaf spots, stem/ root rot can increase the yield and income by 25%.	
Weed management	Cuscuta is a menace in niger farming and controlling through cultural (Seiving before sowing, brine solution steeping before sowing, removal of cuscuta infested seedlings of niger) and chemical methods (Presowing soil application of Fluchloralin, Pre emergences application of Pendimethalin) can lead to increase income of 20 % through increased productivity.	

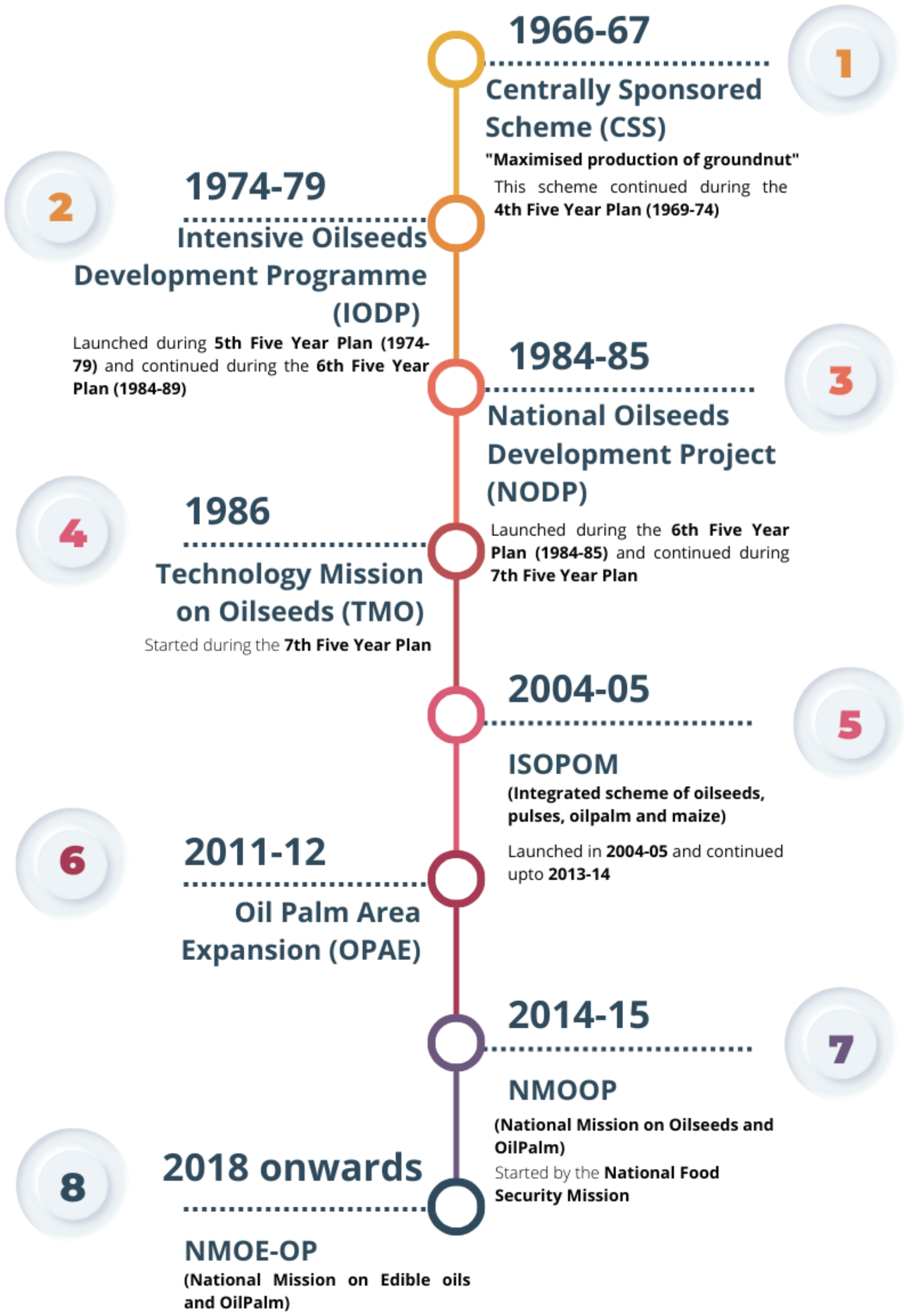
***Source:** IIOR, Hyderabad*

Oilseed Self-Sufficiency: Lessons from the Past Strategies

ANNEXURE- 7

The Indian agricultural sector has historically centred on oilseeds, which hold the second-highest importance after food grains. India is one of the largest importers of edible oil, despite having the title of the world's fourth largest producer of oilseeds. This trend is attributed to the rising demand for edible oils in the private and industrial sectors. The government has implemented various policy changes throughout the post-independence period to address this persistent demand-supply gap. The agricultural climate in India allows the cultivation of 9 oilseeds, i.e., rapeseed, groundnut, niger, castor, sunflower, mustard, sesame, safflower, and soybean, and secondary sources of edible oil include palm oil, rice bran oil, coconut oil, cottonseed oil, tree-based oilseeds, oilseeds etc. To review past policy attempts cautiously in the edible oils sector and devise methods to achieve self-reliance efficiently, it is imperative to review past policy attempts cautiously. These strategies provide us with a structural foundation on which future decisions can be made judiciously. The most prominent government interventions in the oilseeds sector (timeline of past strategies presented below as Figure A7.1), their unique objectives alongside the achievements and limitations are discussed in the chapter.

TIMELINE



Source: Author's own compilation

Figure A7.1: Past Strategies Timeline

i. Centrally Sponsored Scheme (CSS, 1966-67)

This scheme was one of the first significant endeavours for attaining self-sufficiency in oilseed crops. Launched by the government during 1966-67, it reflected the aim of maximizing the production of groundnut. It initially targeted the states of Andhra Pradesh, Karnataka and Uttar Pradesh and later spread to upcoming groundnut growing states such as Gujarat, Maharashtra, Madhya Pradesh, Odisha, Punjab, Rajasthan and Tamil Nadu in the years 1967-68 and 1968-69.

The scheme continued during the 4th Five Year Plan (1969-74), aligning with the goals of stable growth and achieving total self-reliance in the agricultural sector of the economy. Following this initiative, efforts were made in the areas of rapeseed-mustard (R&M), soybean, sunflower, Niger and castor.

Under the CSS, the states were subjected to strategic changes in the areas of oilseed crop yield, cultivation and technological prowess. Financial amenities were centrally provided to the farmers to motivate the use of High Yielding Varieties (HYVs) of crops and modified production techniques. The scheme encouraged the use of modern technology in the areas of irrigation and pest control, as well optimization of resources. It gave farmers the support to explore the upcoming innovations made in agriculture without the fear of suffering colossal losses. This provided an environment ideal for farmers to try different methods to maximize the cultivation of oilseed crops.

Although this scheme envisioned ambitious changes in the cultivation of oilseed crops and subsequent increases in edible oil production, the CSS faced many drawbacks. This was primarily due to challenges in the implementation of these strategies in states of varying climatic as well as regional differences. The demographic of beneficiaries was in line with those of the green revolution, i.e., the small-scale farmers had limited access while the already affluent farmers adopted modern methods swiftly. This added to the already worsened regional inequality.

However, the drawbacks were not solely due to execution obstacles, they can also be linked to unfavourable market conditions caused by recession due to the wars with China and Pakistan, and the devaluation of currency in 1966. The severe drought caused the total food production to fall by 20 % in the year 1965-66. This policy was launched at a time when the agricultural economy of our nation was already suffering. Thus, the impact could not be as transformative.

The CSS cannot be reviewed as a grand success in the field of edible oil policies but it is still considered instrumental in recognizing the importance of formulating public policy to encourage and attain self-sufficiency, which at the time of the 4th plan was in desperate need of. The successes and loopholes of the CSS provide us with a foundational background to analyse the further policies made and to form future ones.

ii. Intensive Oilseeds Development Programme (IODP, 1974-79)

The Intensive Oilseeds Development Programme (IODP) was launched in the year 1974-75 which covered Groundnut, Rapeseed and Mustard, Sesame, Safflower, Linseed and Castor. It was implemented in the major oilseeds growing states like Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Gujarat, Madhya Pradesh, Orissa, etc.

The IODP was launched during the 5th Five Year Plan (1974-79) and continued through the 6th Five Year Plan (1984-89), during which it extended a special project on Groundnut and Soybean. The 5th year plan focused primarily on employment generation which tied in with the idea of oilseed production expansion as encouraged by the IODP. This aimed at creating rural employment. The 6th year plan's main objective was poverty alleviation and improved quality of life. These goals were also closely linked to self-sufficiency in the agricultural sector, considering India's agro-based economic structure.

Like any other initiative, the IODP also faced certain difficulties in its effective implementation. One recurring problem was t uneven impact of the programme. The regions with well-developed infrastructure (irrigation facilities, storage, and transportation) and where farmers had equitable access to resources saw more substantial improvements in production, while other areas with constraints saw limited growth. This uneven distribution reduced the overall impact of IODP on domestic production and imports.

iii. National Oilseeds Development Project (NOPD, 1984-85)

Under acute foreign exchange shortage and rising imports of edible oils, the National Oilseeds Development Project (NODP) was initiated in the year 1984-85, as an import-substitution strategy. It combined all the CSS across the country. The objectives of this project were integrated with the other CSS and hence consisted of the expansion of the area under oilseed cultivation, adoption of HYV oilseeds, financial support along with technology modernization.

NOPD was launched during the 6th Five Year Plan period (1984-85) and continued during the 7th Five Year Plan (1985-86). The 7th Five Year Plan had the main goal of increasing economic growth through agricultural production and employment generation. The project covered major oilseeds producing states of India and aimed at accelerating regional production.

This government initiative had benefits similar to the previously discussed Centrally Sponsored Scheme. These were in the form of increased rural participation and employment opportunities, knowledge dissemination and growth in domestic production of edible oilseed crops and oil. With each government policy initiative, the results in these areas of success kept improving. Hence, although the results of domestic oilseed production weren't tremendous, they were still better than that pre-NODP.

The NODP effectively only had a year to stimulate a desirable growth rate in oilseeds production. Thus, execution challenges did not get enough time to correct themselves, together with other loopholes in the policy. Despite such flaws in the project, it contributed to the successive policies formed thereafter.

iv. Technology Mission on Oilseeds (TMO, 1986)

The Technology Mission on Oilseeds (TMO) was launched in 1986 to increase the production of oilseeds, pulses, and maize. This was another attempt at reaching self-reliance in edible oil and reducing import dependency. The mission aimed at doing so by dissemination of modern technology and better farm practices, easing the availability of various types of oilseed crops and HYV seeds, strategizing post-harvest techniques to minimize losses and increase shelf life, and encouraging research and development in oilseeds, pulses and maize. Schemes for price support, storage, processing and marketing were initiated as well.

TMO was launched alongside the continuation of the NODP on a 50:50 sharing basis between the Central and State Governments. A special project entitled Oilseeds Production Thrust Project (OPTP) was also established, with 100% assistance from the Central Government. The OPTP was initiated to accelerate the growth of four major oilseeds crops, i.e. groundnut, mustard, soybean and sunflower, which constituted 85% of the total oilseeds production. A sum of 246 districts in 17 States, including 151 NODP districts was included in this programme. These programmes continued under the nomenclature of TMOP till 2003-04 with 100% assistance under OPTP up to 1990-91 and, thereafter, as a single oilseed production programme on a 75:25 sharing basis.

There were various schemes initiated under the TMO, such as (i) Oil Palm Development Program, (ii) Oilseeds Production Program, (iii) National Pulses Development Project, (iv) Post-Harvest Technology, (v) Accelerated Maize Development Program, and (vi) National Oilseeds and Vegetable Oil Development Board.

This mission was started during the 7th Five Year Plan (1985-1990), which highlighted the importance of upgrading technology in improving the productivity of the economy. TMO aligned with this objective and focused thoroughly on the adoption of modern technology in agriculture. It aimed at reducing the heavy imports of edible oils by the end of the 7th Five Year Plan and consequently achieving self-reliance by the end of the 8th Five Year Plan.

The Department of Agriculture & Cooperation (DAC) was leading the role of providing input and service support to farmers. By 1995, DAC started a Rs. 170-crore National Oilseeds Development Project, in 180 districts located in 17 States. This was done to establish a diverse range of services to farmers, unique to their agro-climatic conditions, local practices, level of infrastructure, and availability of resources. These services encompassed the distribution of seeds, fertilizers and bio-fertilizers, pesticides, implements and credit. Later on, projects were established by ICAR like Operation Research Project, National Demonstrations and Krishi Vigyan Kendras, to spread improved technology.

The NODP and OPTP were subsequently merged into the Oilseed Production Programme (OPP).

The success of TMO was seen in the development of around 40 new varieties of oilseed crops. The yield potential of these crops was four times the national average under research farm conditions and at least twice the national average under normal farm conditions. The first three years of the mission saw a 193% spurt in the production of breeder seeds. The Council of Scientific and Industrial Research (CSIR) introduced batch-type processes for rice bran stabilization and sunflower decortication, and improved expellers, in the year 1988-89. Edible oil consumption volumes experienced a growth of 4% in the period from 1998-99 to 2001-02 under the TMO.

However, the achievements made under the Integrated Policy on Oilseeds (IPO) are of paramount importance. The IPO was followed by the Market Intervention Operation (MIO), which is another pioneering initiative in the edible oils industry.

The IPO was a recommendation made by the TMO to the government in 1988 and was formally adopted by the government in January 1989. It was set to tackle the lack of integration between different Ministries and Departments. Thus, the IPO gave an integrated approach to the oil economy. The aim was to integrate oilseed production, import, distribution and pricing. The IPO had 5 core elements : (i) Farmers were to be provided with government support in the purchase of inputs, technology, etc. (ii) Fixation of a price band, (iii) An Empowered Committee was established, headed by the Cabinet Secretary, to monitor the implementation of the Integrated Policy, (iv) NDDB was appointed as the Market Intervention Agency (MIA), and (v) Evaluation of the Public Distribution System such that they do not detriment interests of farmers, and issue prices to vanaspati industry. Imported prices would not be supplied at prices lower than domestic costs of production.

The Technology Mission on Oilseeds was a policy breakthrough in the industry of edible oils. It provided an integrated approach to an industry that lacked coordination. The advancements made during the TMO paved the way for the success of many current government missions. However, the impact of the TMO was constrained in many areas by the recurring issues of inadequate infrastructure, lack of essential facilities like cold storage, unavailability of advanced technologies, and financial limitations of small and marginal farmers. The increasingly favourable returns in wheat and rice led to a decline in oilseed acreage, which lowered oilseed production. This limited the extent of the regional success of the TMO.

v. Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize (ISOPOM, 2004-05)

The Technology Mission on Oilseeds was restructured as the Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize (ISOPOM) in the year 2004-05. As a new CSS, ISOPOM now included oil palm and continued during 2013-14 on a 75:25 sharing basis between the Central government and the State governments. ISOPOM was implemented in 14 potential states for oilseeds and pulses, 15 states for maize and 12 states for oil palm. The ISOPOM oil palm states include Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat, Goa, Orissa, Kerala, and Mizoram.

The Department of Agriculture & Cooperation implemented four Centrally Sponsored Schemes under TMOP&M: (i) Oilseeds Production Programme (OPP), (ii) National Pulses Development Project (NPDP), (iii) Accelerated Maize Development Programme (AMDP), and (iv) Oil Palm Development Programme (OPDP). During the 10th Five Year Plan, these four schemes were modified and combined into one Centrally Sponsored Scheme of Pulses, Oil Palm, Oilseeds, and Maize, i.e. ISOPOM.

The goals of the 10th Five-Year Plan followed the lines of consistent GDP growth, poverty alleviation and employment generation. India being an agriculture-based economy with more than half of the population residing in rural areas, tapping into areas such as oilseed crops and edible oil production, provided the immense potential for employment opportunities and increasing GDP by growing domestic production.

The Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize had some core unique features. Firstly, it allows state governments to utilize the funds for the crop/area of their choice, by regional requirements. This was essential to curtail the regional disparities caused by the unequal distribution of HYV seeds, technology and other agricultural amenities. The State governments had the liberty of formulating an annual action plan which would be approved by the Central government. Thus, this gave states flexibility to introduce innovative techniques/schemes to the extent of 10% of financial allocation.

Under ISOPOM, private sector participation was also actively incentivized by State Governments following a financial cap of 15%. This was done post-liberalization to increase involvement and contribution, which the public sector lacked.

The trend of the area was targeted and achieved from 2004 onwards during ISOPOM under the Oil Palm Development Programme, which saw a gap of no more than 3000 hectares. The total area under Oil Palm cultivation in India grew from 8321 hectares (2004-05) to 17925 hectares (2010-11).

The area of cereals and oilseeds increased during the period while the area of Pulses decreased. The total production of cereals, pulses and oilseeds also witnessed an increase during the period. ISOPOM had visible impacts on the increase of edible oil production and oilseed crop production. However, it is hard to attribute these successes solely to ISOPOM. The National Food Security Mission was launched in the year 2007 and had objectives overlapping with those under ISOPOM.

Similar to the setbacks faced by the preceding missions and schemes, ISOPOM also suffered implementation challenges. These were however less detrimental as the policy established integration and close coordination between the Central and State governments, and the various Ministries and Departments involved.

Another loophole in its execution was regarding insufficient support to processing units. Fresh fruit branches (FFBs) of oil palm must be processed within 24 hours of harvesting. Such lack of oil palm mills dissuaded farmers from expanding the area of oil palm plantations, this was particularly an issue in Mizoram. In many states where plantations started bearing FFBs, cultivators took to destroying their yield in the absence of adequate provisions for processing them.

The Indian economy as a whole also saw an increase in the GDP growth rate during the early years of the 2000s. This provided producers with a relatively stable market dynamic as compared to market and economic conditions during the launch of previous strategies in the oilseeds sector.

vi. Oil Palm Area Expansion (OPAE, 2011-12)

The Oil Palm Area Expansion (OPAE) was launched with the aim of bringing 6000 hectares of land under oil palm cultivation during the year 2011-12. It was sought to do so through farmer incentives in the form of planting material, compensation for losses during the gestation period, pump set, drip irrigation system, support for intercropping, vermicompost pit, bore wells/water harvesting tanks/fertigation tanks, PP chemicals/INM/IPM/fertigation/tree guards, etc.

This scheme was very ambitious in its endeavour to rapidly grow the area under oil palm production. Oil palm plantations have a gestation period of 4 years, during which the government would provide necessary support to the growers. The farmers were also encouraged by the government to grow intercrops during the gestation period (until the oil palm started bearing fresh fruit branches). Funds amounting to Rs 151.50 crore were allocated for the 3 years, 2012 onwards.

The problem of expanding the area under oil palm cultivation had surfaced during the Oil Palm Development Programme under ISOPOM. After cultivators requested the Government of India to provide appropriate amenities, the government, through OPAE, decided to grant subsidies for setting up oil palm mills through the State Department of Agriculture. A subsidy of 50% of the cost of plant and equipment, limited to Rs. 250 lakh per unit of 5 MT/hour FFBs capacity through the State Department of Agriculture, was allocated. This was proposed to maintain farmer's confidence and further encourage potential but hesitant cultivators of oil palm.

Moreover, OPAE undertook many research and development initiatives through the State Department of Agriculture / Horticulture. This was done in an attempt to devise methods to promote area expansion and confidence building among oil palm growers.

This discrepancy can be attributed to factors such as execution limitations, the negative ecological effects of oil palm cultivation (deforestation, soil pollution, erosion, etc.), farmer scepticism due to the long gestation period, insufficient means to correct soil damage and processing/storage issues of FFBs.

vii. National Mission on Oilseeds and Oil Palm (NMOOP, 2014-15)

ISOPOM was restructured into the National Mission on Oilseeds and Oil Palm (NMOOP) in the year 2014-15. The target set by the mission was to achieve the target production of 9.51 MT of vegetable oils (TBOs, Oil Palm, and Oilseeds) from 7.06 MT.

It was launched to increase the productivity of oilseed crops and oil palm along with their production. It sought to bring fallow areas under oilseed crops and diversification of area from low-yielding cereals, for the same. Funding of research and development, together with technological intervention, was given paramount importance. The funding scheme for NMOOP follows a 75:25 ratio of sharing between the State and Central Governments.

The results of ISOPOM exposed the need for strong research backing for a successful mission. Provisions were specifically made to correct the issues of region-specific disparity and to extend technological dissemination to the grassroots level. This mission was strictly in line with the goals of the 12th Five-Year Plan.

- NMOOP had three micro missions:
- Micro-mission 1 was based primarily on oilseed crop expansion in a total of 19 states. It targeted an increase in oilseeds production to 35.51 MT in the 12th Plan.
- Micro-mission 2 was focused on Oil Palm cultivation and productivity maximization, initiated in 19 states. The goal was to bring 1.25 Lha area under oil palm cultivation through the conversion of wasteland into palm plantations. FFBs productivity was also aimed to rise to 15000 kg per hectare. It also promoted inter-cropping in oilseeds plantations with cereals(pulses) and sugarcane.

- Micro-mission 3 was for TBOs. This was a fairly new venture in the edible oil sector and initiated in 28 states, which aimed at growing seed collection of TBOs to 14 lakh tonnes. Inter-cropping was encouraged by this mission as well.

The mission aimed to increase edible oil production by bringing a target of 75,000 hectares of area under palm cultivation, with special emphasis on Northern-Eastern states. Farmers were to be assured assistance through financial amenities during the production process, the Market Intervention Scheme (offering good FFBs prices in lieu of the international trends in Crude Palm Oil prices), and other agricultural services.

The production of the 9 oilseeds has not seen continuous growth over the duration of the mission. The fluctuations can be attributed to state-specific issues. These were recorded by the National Food Security Mission (NFSM) in the form of state-wise progress reports.

In many states, the Oil Palm Development Programme did not reach satisfactory levels. The gap between the target fixed and achievements can be attributed to irregular progress reports, unforeseen halts of the mission in some states and insufficient and delayed efforts (expenditure, proposals, projects, etc.) from State governments and Departments. Although opulent states such as Andhra Pradesh, Gujarat, Haryana and Karnataka saw substantial growth in oilseeds production and oil palm area expansion, the aggregate production figures were pulled down by the improper implementation.

NMOOP provided satisfactory growth in oilseeds and oil palm production in several states and gave states that struggled with accelerating production an opportunity to employ new technologies and agricultural methods, with support from the government. NMOOP propelled the growth of the production and area expansion under oilseeds crops and has been the foundation of the current agricultural policies made in the oilseeds sector. Its emphasis on oil palm and state-specific application has been a pioneering force in the growth of oilseeds cultivation and edible oil production.

viii. National Mission on Edible Oils and Oil Palm (NMEO-OP, 2018-19)

During 2018-19, the vegetable oil imports had increased by more than 3%. This revealed the immediate need to bridge the growing gap between India's demand for edible oils and the domestic supply. To minimize such dependency on imports, the government of India launched a new mission.

The NMOOP was merged with the National Food Security Mission as NFSM-OS&OP, which has been subsumed by the National Mission on Edible Oils and Oil Palm (NMEO-OP). This is the current mission being implemented in the oilseeds sector.

The NMEO-OP has targeted an increase of oil palm area to 10 Lha from 3.5 lakh ha during 2019-20 by 2025-26). 3.22 lakh ha is targeted for the states in general and 3.28 lakh ha in North Eastern states with targeted FFBs production of 66.00 lakh tonnes. An Increase in consumer awareness to maintain a consumption level of 19.00 kg/person/annum till 2025-26, is another vision of NMEO-OP.

Special aid is to be provided to farmers under this mission. Those opting for oil palm cultivation will get price assurance from the government. This is to encourage domestic growth and reduce edible oil dependency on imports. The edible oils market has the potential to flourish in India and it is an excellent opportunity for farmers to capitalize. The scheme also directs particular stress on the North-Eastern states along with Andaman and Nicobar Islands, which have a conducive agricultural environment for oilseed crops but lack infrastructure and institutional backing.

The mission plans on reaching its seedling production targets through seed gardens and oil palm nurseries. It aims to increase FFBs productivity, drip irrigation facilities and encourage diversification of area from yielding cereals cross to oil palm and intercropping during gestation periods, in order to guarantee income amidst zero production. The aforementioned stakeholders are the centre of this mission's successful execution.

As of now, there is insufficient data and too early on in the mission's endeavour to be able to judge its impact. However, it being the culmination of decades of government efforts and experience in the edible oils sector promises the success of NMEO-OP.

Past policy initiatives in the oilseeds sector serve as a valuable foundation for shaping future strategies. These initiatives have demonstrably contributed to sectoral growth, reduced import dependence, and enhanced food security. However, their implementation has also revealed sustainability concerns that need careful consideration. Through a critical analysis of past policies, including their achievements and shortcomings, we can gain valuable insights to address future challenges and opportunities in agricultural development. By understanding the successes and limitations of previous approaches, we can propose more effective strategies that promote sustainable productivity, consistent research and development, and ultimately, achieve self-reliance in edible oils.

ACKNOWLEDGED SOURCES

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GLIMPSE OF PRIMARY SURVEY CONDUCTED BY NITI AAYOG IN 7 STATES

Glimpse of Primary Survey Conducted by NITI Aayog in 7 States

Field visit to Bharatpur and Alwar, Rajasthan

Field visit to Raisen and Narmadapuram, MP

Field visit to Sheopur, Madhya Pradesh


Field and KVK visit to Jhansi, Uttar Pradesh


Field visit to Karnataka

Field visit to Srikakulam, Andhra Pradesh


Field Visit to Sirsa, Haryana

Field visit to Washim and Buldana, Maharashtra

Stakeholders' consultations held in NITI Aayog

Designed by:

AKHYA INDIA

सत्यमेव जयते

NITI Aayog