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Outcomes of oilseed and oil palm development programmes in India: A comprehensive review

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Abstract

Oilseeds play a vital role globally and nationally, serving as essential sources of edible oils, livestock feed, and industrial inputs. Over recent decades, the global demand for edible oils has surged, with India's per capita consumption and overall requirements rising sharply, thereby exerting pressure on domestic production and trade systems. In response, India has launched a series of policy interventions, including the Maximized Production of Groundnut (1966), Intensive Oilseeds Development Programme (1974), National Oilseeds Development Project (NODP), Technology Mission on Oilseeds (TMO), Integrated Scheme on Oilseeds, Pulses, Oil Palm, and Maize (ISOPOM), and the National Mission on Oilseeds and Oil Palm (NMOOP). This paper presents a comprehensive review of the various oilseed development programmes implemented in India and evaluates their contribution in increasing oilseed production, yield, and self-sufficiency. For present study, secondary data from government agencies, peer-reviewed journals, evaluation reports, and official documents was synthesised with a focus on identify the trends from post green revolution till date. It was observed that initiatives such as Cluster Frontline Demonstrations (CFLD) have played crucial role in promoting modern production technologies leading to bridging yield gaps. After implementation of CFLD programme on oilseeds, India's oilseed production increased by over 20%, with productivity gains attributed to interventions that improved seed systems, agronomic practices, and technology adoption. Despite these achievements, there is existence of demand-supply gap as the population is increasing and industrial demand is also increasing leading to fulfilment of demands by importing edible oils and oilseeds. The study suggests the need to upscale successful models, strengthen extension and market linkages, and implement strategies for consumption moderation and nutritional diversification. for achieving self-sufficiency and sustaining growth in India's oilseed sector.

Keywords: Oilseed productivity, self-sufficiency, cluster frontline demonstrations technology, mission on oilseeds national, mission on oilseeds and oil palm policy interventions, demand-supply gap and climate-resilient cultivars

Introduction

Oilseeds constitute one of the most important groups of crops globally, providing not only edible oils for human consumption but also protein-rich meal for livestock and raw materials for industrial use. According to FAO (2022), global demand for edible oils has been rising steadily due to population growth and dietary diversification. The World Health Organization (WHO, 2021) has highlighted that per capita consumption of vegetable oils globally increased from 18.5 kg in 2000 to over 27 kg in 2020, with projections of 32 kg by 2030. This trend places immense pressure on both production and trade systems. India holds a significant position in the global oilseed economy, cultivating nearly 20% of the world's oilseed area but contributing only about 6–7% of production due to lower yields (DAC&FW, 2023). Groundnut, rapeseed-mustard, soybean, and sunflower are the major oilseed crops grown. The demand-supply gap has widened over the time leading India to become the largest importer of edible oils, fulfilling more than half of its requirement from foreign markets. To promote oilseed production for self-sufficiency, many programmes were launched after independence in India as mentioned in the Table 1. The focus of early programmes such as the

Maximized Production of Groundnut (1966) and the Intensive Oilseeds Development Programme (1974) was primarily on area expansion. In contrast, later initiatives including the National Oilseeds Development Project and the Technology Mission on Oilseeds (mid-1980s) marked a shift towards a technology-led productivity paradigm supported by integrated policy approaches. Subsequent integrated schemes such as ISOPOM (2004) emphasized production enhancement and input-use efficiency, whereas the National Mission on Oilseeds and Oil Palm (NMOOP), launched in 2014, placed greater emphasis on yield improvement and area expansion to achieve sustainable growth in oilseed and oil palm production and reduce import dependence. Under Mission I and II of NMOOP, the major thrust was on seed replacement, yield enhancement, and production improvement for oilseeds, along with area expansion and productivity enhancement in oil palm through technology adoption (Table 1). In the year 2015-16, the programme 'Cluster Front Line Demonstrations' (CFLDs) on Oilseeds was initiated by the Ministry of Agriculture and Farmer's welfare, Government of India, New Delhi under National Mission on Oilseeds and Oil Palm (NMOOP). The division of Agricultural Extension,

Indian Council Agricultural Research (ICAR), New Delhi put responsibility to lay out CFLDs on important oilseed crops such as sesamum, rapeseed and linseed through Krishi Vigyan Kendras (KVK) through eleven ICAR-Agricultural Technology Application Research Institutes (ATARI) all

over India with an aim to increase the productivity of oilseeds throughout the country as the production of edible oil in India is still deficit as per requirement (Saikia *et al.* 2024) ^[17].

Table 1: Major Oilseed Development Programmes in India

Programme Name	Year	Focus	Objectives
Maximized Production of Groundnut	1966	Area expansion & increase in production	Increase groundnut production via demonstrations
Intensive Oilseeds Development Programme (IODP)	1974	Increase in area, production, yield	Enhance production of multiple oilseeds including groundnut, rapeseed, sesame
National Oilseeds Development Project (NODP)	1984	Production improvement, seed replacement	Improve technology adoption and seed replacement
Technology Mission on Oilseeds (TMO)	1986	Yield, production, varietal adoption	Promote yield increases through R&D, inputs, and extension
Integrated Scheme on Oilseeds, Pulses, Oil Palm and Maize (ISOPOM)	2004	Production, input efficiency	Integrate multiple crop programmes to boost area and productivity
National Mission on Oilseeds and Oil Palm (NMOOP)	2014	Production, yield, area expansion	Increase oilseed and oil palm production sustainably; reduce imports
Mini Mission-I: Oilseeds (under NMOOP)	2014	Seed replacement, yield, production	Boost oilseed production via seed replacement & technology adoption
Mini Mission-II: Oil Palm (under NMOOP)	2014	Area expansion, FFB yield	Expand oil palm cultivation area and productivity
Mini Mission-III: Tree Borne Oilseeds (TBOs)	2014	Area coverage, seed collection, oil production	Increase TBO seed collections and plantings
Oil Palm Development Programme (OPDP)	1992	Area expansion, FFB production	Promote oil palm cultivation through subsidies and technical support
Special Programme on Oil Palm Area Expansion (OPAE)	2011	Area expansion, farmer income	Expand oil palm area, especially supporting small/marginal farmers
Cluster Frontline Demonstrations (CFLD) on Oilseeds	2015	Number of demos, yield increase, seed replacement	Demonstrate improved production technologies on farms for yield and practice adoption

Methodology

To assess the impact of different programme launched in India for promotion of oilseeds, this review synthesizes secondary data derived from government publications (India Stat, DAC&FW reports), peer-reviewed journals, and official programme documents. Data on oilseed area, production, productivity, seed replacement, and income impact related to various development programmes were collated. Statistical trend analysis, including growth rates and percentage changes over time, was employed to assess long-term programme impacts. Special emphasis was placed on programme evaluation reports, frontline demonstration results, and state-level productivity survey findings, covering the period 1966 to 2024. Recent CFLD impact assessments (2014–2024) were included to gauge technology adoption effects. Narrative synthesis and comparative analysis were undertaken to contextualize measurable programme outcomes and identify persistent sectoral challenges.

Results

The state-wise oilseed area and production data reveal the effectiveness of developmental programmes across India between 2014 and 2024. Among states, Andhra Pradesh, a historically important groundnut and sesame producer, experienced a contraction in cultivated oilseed area by 15.4%, decreasing from 1.3 Mha to 1.1 Mha in 2024 whereas, its oilseed production declined by 16.7%. This shrinkage signals shifts in cropping priorities or possible climatic and market challenges. In Maharashtra FLDs organized by the KVK in Konkan Region had enhanced the

yield of oilseed crops vertically and ensured rapid horizontal expansion of recommended technologies of oilseed crops (Patil *et al.* 2018) ^[19]. Uttar Pradesh demonstrated robust growth with a 16% increase in oilseed area (from 1.11 million to 1.28 million hectares), translating into a substantial 29.3% production increase to 1.16 million tonnes. Gujarat observed a noticeably reduced groundnut and mustard area by nearly 12%, resulting in a 16.9% production fall of over 1 million tonnes. Jharkhand, while stable in area, registered a remarkable production gain of over 50%, highlighting yield improvements likely due to focused extension and technology transfer. Several northeastern and hilly states such as Arunachal Pradesh, Assam, Mizoram, and Meghalaya displayed moderate area expansion (up to ~30%) with corresponding moderate to strong production rises, evidencing the spread of oilseed cultivation into new territories. In Madhya Pradesh, Cluster Frontline Demonstration trials were conducted under the supervision of scientists at farmers' fields; however, a yield gap between potential and demonstration yields still exists which ranges from 1.90 q/ha in blackgram variety Pratap urd 1 to 8.60q/ha in soybean JS95-60. This may be due to soil fertility, weather and agro-climatic condition (Singh *et al.* 2018) ^[18]. The states of Karnataka and Odisha showed mixed trends. Karnataka's oilseed area decreased by 3.7%, but production declined significantly by 30.1% indicating challenges in productivity or crop shifts. Odisha showed a 3.7% dip in area accompanied by a steep 35.2% production decline, illustrating regional constraints such as climatic stress or input limitations. Punjab and West Bengal maintained relatively stable oilseed areas with small growth

(<5%) and moderate production increases (+9.3% and +15.8% respectively), reflecting steady regional performance. Conversely, Kerala and Goa's oilseed areas reduced considerably with production dropping proportionately, suggesting limited expansion scope in these regions. The oilseed crop yields recorded by farmers prior to FLD activities were 2.1, 9.5 and 5.96 q ha⁻¹ for sesame, soybean and mustard, respectively. These yields increased to 6.2, 15.67 and 14.01 q ha⁻¹ following FLD interventions. The increase in yield was found to be 195, 63.34 and 135

per cent respectively for sesame, soybean and mustard crop. Thus, it is clear that the FLD programme had a positive impact over the existing practices in enhancing the oilseed crop productivity (Singh *et al.* 2014) [16]. Overall, this data underscores varied regional responses to national oilseed development programmes. States such as Madhya Pradesh, Uttar Pradesh, Rajasthan, and Jharkhand exemplify positive programme impact with area or yield increases driving production gains.

Table 2: State-wise and Crop-wise Area and Production of Oilseeds in India (2014–2024)

State	Major Oilseed Crops	Area (000, ha)		% Area Change	Production (000, Mt)		% Prod. Change
		2014	2024		2014	2024	
Andhra Pradesh	Groundnut, Sesame	1,300	1,100	-15.40%	1,200	1,000	-16.70%
Arunachal Pradesh	Sesame, Niger	33	34	2.40%	31	33	4.50%
Assam	Mustard, Sesamum	304	307	1.00%	186	209	12.20%
Bihar	Rapeseed-Mustard	123	121	-2.00%	146	117	-19.80%
Chhattisgarh	Soybean, Groundnut	289	292	0.75%	185	126	-32.10%
Goa	Arecanut, Oil Palm	2,600	2,500	-3.80%	6,6	56	-15.10%
Gujarat	Groundnut, Mustard	308	271	-11.90%	69	571	-16.90%
Haryana	Mustard	549	557	1.50%	899	870	-3.20%
Himachal Pradesh	Rapeseed, Mustard	12	12	0.00%	6,100	63	3.30%
Jammu & Kashmir	Mustard	65	61	-6.50%	58	38	-35.00%
Jharkhand	Sesame, Groundnut	275	278	0.90%	183	277	51.50%
Karnataka	Groundnut, Soybean	1,410	1,358	-3.70%	1,162	812	-30.10%
Kerala	Coconut, Sesame	1,000	700	-30.00%	1,000	800	-20.00%
Madhya Pradesh	Soybean, Mustard	7732	7330	-5.20%	7634	6948	4.70%
Maharashtra	Soybean, Groundnut	4,148	4,160	0.30%	5293	4233	-20.10%
Manipur	Mustard	10	11	10.00%	75	85	13.30%
Meghalaya	Mustard	5	55	10.00%	32	34	6.25%
Mizoram	Oil Palm	28	30	6.00%	NA	NA	NA
Nagaland	Mustard	4	4	5.00%	2	2	7.40%
Odisha	Groundnut, Sesame	223	215	-3.70%	168	109	-35.20%
Punjab	Mustard	48	46	-3.10%	64	70	9.30%
Puducherry	Groundnut	700	680	-2.90%	850	820	-3.50%
Rajasthan	Mustard, Soybean	527	483	-8.30%	603	606	0.50%
Sikkim	Mustard, Oil Palm	1	1	5.60%	1	1	7.70%
Tamil Nadu	Groundnut, Sesame	408	401	-1.60%	964	956	-0.80%
Telangana	Groundnut, Oil Palm	388	472	21.70%	471	603	28.00%
Tripura	Sesame, Mustard	6	7	29.50%	4	5	26.10%
Uttar Pradesh	Mustard, Rapeseed	1,106	1,282	16.00%	895	1158	29.30%
Uttarakhand	Rapeseed, Mustard	318	302	-5.00%	341	27	-20.80%
West Bengal	Mustard, Rapeseed	770	781	1.40%	909	1,053	15.80%

Source: DES AGRI 2024, ICAR IIOR 2024 and USDA 2025

The analysis reveals that India's oilseed sector has undergone noteworthy development over the past decades, supported by national programmes, technological adoption, and policy initiatives. Oilseed production has steadily increased from about 34.9 million metric tonnes (MMT) in 2010-11 to 41.9 MMT by 2024-25 (USDA FAS, 2025; DES, 2024). This 20.6% growth signals advance in crop management, high-quality seed adoption, and area expansion in key states, particularly Madhya Pradesh, Rajasthan, and Uttar Pradesh (India Stat, 2025; ICAR-IIOR, 2025). Exports of oilseeds remain much lower but have gradually increased, highlighting niche successes in value-added or quality products. Despite increased production, India continues to import major quantities of edible oils such as palm oil, which yield more oil per hectare compared to many traditional oilseeds (IBEF, 2024).

Table 3: Oilseed Area, Production and Productivity in India (2010–2025)

Year	Area (Mha)	Production (Mt)	Productivity (kg ha ⁻¹)	Increase/decrease in Productivity
2010	26.3	24.9	947	–
2012	26.1	29.8	1,142	+20.6%
2014	25.6	32.8	1,281	+12.2%
2016	26.0	33.6	1,292	+0.9%
2018	26.5	35.1	1,325	+2.6%
2020	27.1	33.2	1,225	–7.5%
2022	28.0	37.1	1,325	+8.2%
2024	28.7	38.5	1,342	+1.3%
2025	29.0	39.2	1,352	+0.7%

Source: Directorate of Economics and Statistics, MoAFW (2010–2025)

Between 2010 and 2025, the oilseed area in India increased only marginally (10.2%), while production rose by 57.5%. Productivity improved from 947 kg ha⁻¹ in 2010 to 1,352 kg ha⁻¹ in 2025, reflecting a 42.7% gain. These improvements are largely attributable to varietal replacement, improved agronomic practices, and targeted interventions through government schemes. Despite productivity gains, India's

edible oil import dependency remains a major challenge. Imports rose from 9.0 Mt in 2010 to 16.0 Mt in 2025, reflecting a 77.8% increase. The share of imports in domestic demand remained between 52–59%, indicating persistent dependency. Palm oil dominates imports, followed by soybean and sunflower oils.

Table 4: Imports of Edible Oils in India (2010–2025)

Year	Import Volume (Mt)	Share in Domestic Demand (%)	Major Oils Imported
2010	9.0	52	Palm, Soybean
2012	10.2	53	Palm, Soybean
2014	11.6	55	Palm, Soybean
2016	14.0	58	Palm, Soybean, Sunflower
2018	15.2	59	Palm, Soybean, Sunflower
2020	13.5	56	Palm, Soybean, Sunflower
2022	14.3	57	Palm, Soybean, Sunflower
2024	15.5	58	Palm, Soybean, Sunflower
2025	16.0	59	Palm, Soybean, Sunflower

Source: Solvent Extractors' Association of India (SEA, 2010–2025); DES, MoAFW.

The implementation of different oilseed development programmes namely Maximized Production of Groundnut and Intensive Oilseeds Development Programme (IODP) helped to expand groundnut area across major states and incremental production growth, contributes in moderate production gains. Other programmes like National Oilseeds Development Project (NODP) helped to enhance oilseed production and seed replacement improvements, Technology Mission on Oilseeds (TMO), Integrated Scheme on Oilseeds, Pulses, Oil Palm and Maize (ISOPOM),

National Mission on Oilseeds and Oil Palm (NMOOP), Mini Mission-I, II and III Oilseeds (under NMOOP), Special Programme on Oil Palm Area Expansion (OPAE), Oil Palm Development Programme (OPDP) and Cluster Frontline Demonstrations (CFLD) on Oilseeds focuses majorly on area expansion (Table 5). Overall, India's oilseed development journey exemplifies how coordinated policy, technology dissemination, and farmer engagement can substantially improve agricultural output.

Table 5: Impact of different Oilseed Development Programmes in India

Programme Name	Impact Indicators	Impact
Maximized Production of Groundnut	Area & production	Expanded groundnut area across major states in the 1960s; incremental production growth.
Intensive Oilseeds Development Programme (IODP)	Area, production, yield	Moderate production gains during the 5th-6th Plans.
National Oilseeds Development Project (NODP)	Production, seed replacement	Production rose from 6.43 MT (1966) to 22.11 MT (1995); significant seed replacement improvements.
Technology Mission on Oilseeds (TMO)	Yield, production, varietal adoption	Production doubled (12.1 to >20 MT from 1985-94); yields tripled (~428 to 1168 kg/ha, 1966-2014).
Integrated Scheme on Oilseeds, Pulses, Oil Palm and Maize (ISOPOM)	Production, input efficiency	Production steady at ~29 to 30 MT (2007-17); acreage ~26 million ha; annual funding Rs. 507 to 584 crore.
National Mission on Oilseeds and Oil Palm (NMOOP)	Production, yield, area expansion	Oilseed production ~33.6 MT (2016-17); oil palm area expanded to ~331,000 ha (2017-18); funding Rs. 500 crores.
Mini Mission-I: Oilseeds (under NMOOP)	Seed replacement, yield, production	Minikit distribution 40 lakh kits (2017-18); yield increase to 1.3 t/ha (2017-18) from 1.1 t/ha (2013-14).
Mini Mission-II: Oil Palm (under NMOOP)	Area expansion, FFB yield	Area expanded 95,600 ha during XI Plan; total area 331,000 ha (2017-18); FFB production 1.63 MT (2017-18).
Mini Mission-III: Tree Borne Oilseeds (TBOs)	Area coverage, seed collection, oil production	Seed collection target raised from 9 to 14 lakh tonnes by 2022; oil production ~1 lakh tonnes.
Oil Palm Development Programme (OPDP)	Area expansion, FFB production	Area increased from ~8,585 ha (1991) to >316,000 ha (2016); FFB production >60-fold increase.
Special Programme on Oil Palm Area Expansion (OPAE)	Area expansion, farmer income	Added 60,000 ha oil palm plantations (2011-14).
Cluster Frontline Demonstrations (CFLD) on Oilseeds	Number of demos, yield increase, seed replacement	23,118 demos (2014 to 24) achieved average 51.3% yield increase across major crops; income increase up to Rs 1,07,940/ha (sunflower); seed minikit distribution above 40 lakh kits.

Discussion

India's oilseed sector has exhibited commendable progress over the past decade, underpinned by effective government

policies, technological advancements, and proactive development programmes such as the Technology Mission on Oilseeds and the National Mission on Oilseeds and Oil

Palm. These initiatives have led to increased production and narrowed yield gaps in several key states, enhancing farmer incomes and contributing to rural economic stability. The implementation of various oilseed development programmes has focused on yield enhancement, area expansion, diversification into high-yielding crops such as soybean and sunflower, and integration of tree-borne oils and oil palm cultivation. The National Mission on Oilseeds and Oil Palm (NMOOP), along with Cluster Frontline Demonstrations (CFLD), has been pivotal in improving productivity and production since 2014. Nonetheless, the data reveal that bridging the demand-supply gap demands continued and intensified focus on agricultural innovation, extension services, supply chain efficiencies, demand moderation through consumer awareness, and strategic trade policy to manage import dependencies. India's oilseed production and consumption dynamics over the past decades reveals a complex interplay between supply, demand, and trade balances influenced by production growth, consumption patterns, and import reliance. Between 2010 and 2024, the country's oilseed production exhibited an upward trend, increasing from approximately 34.9 million metric tonnes (MMT) in 2010-11 to 41.9 MMT in 2024-25. This growth is attributed to enhanced productivity, adoption of improved varieties through various developmental programmes, and expansion in cultivated area in some states. During the period, domestic demand for oilseeds escalated concurrently, driven by rising population, increasing per capita edible oil consumption, and expanding industrial uses related to food processing and livestock feed. The demand figures rose from about 31.4 MMT in 2010-11 to 47.5 MMT by 2024-25, surpassing production volumes and resulting in a widening demand-supply gap. This gap reflects India's substantial dependence on imports, primarily of edible oils and oilseeds, to bridge the shortfall and stabilize domestic supply. Between 2010-11 and 2014-25, the nation's import volumes escalated from 4.2 million tonnes in 2010-11 to 16 million tonnes by 2024-25, while exports remained comparatively low but showed gradual increases from approximately 0.6 to 1.4 million tonnes. The net import figures, therefore, have climbed significantly, indicating sustained import reliance despite domestic production gains. India's oilseed sector is showcasing a transition from early focus on area expansion to a technology-led productivity paradigm and integrated policy approaches. Early programmes like Maximized Production of Groundnut (1966) and the Intensive Oilseeds Development Programme (1974) laid foundational agricultural practices but had limited yield impact. The National Oilseeds Development Project and the Technology Mission on Oilseeds (launched in the mid-1980s) marked a pivotal shift by promoting improved seed varieties, agro-input access, and extension services, which significantly enhanced production from 6.43 million tonnes in 1966-67 to over 22 million tonnes by the mid-1990s. Subsequent integrated schemes such as ISOPOM (2004) sought better coordination across crop sectors but faced challenges from market competition and input inefficiencies, resulting in moderate growth in area and production. The advent of the National Mission on Oilseeds and Oil Palm (NMOOP) in 2014 reflected modern agricultural policy emphasis on sustainability, diversification, and fortified supply chains. Significant

achievements include large-scale area expansions under oil palm and steady productivity gains under Mini Mission-I for oilseeds. Demonstration yields exceed national averages by up to 51%, with net income improvements reflecting tangible benefits to cultivators. The most important characteristics identified were education, innovativeness, and social participation, which significantly influenced yield gaps in oilseed crops (Sri *et al.* 2022) ^[20].

Conclusion

The analysis clearly indicates that India's oilseed sector has progressed substantially from an area-expansion-oriented approach to a technology-driven and policy-integrated development pathway. National programmes such as the Technology Mission on Oilseeds, ISOPOM, and particularly the National Mission on Oilseeds and Oil Palm (NMOOP), supported by Cluster Frontline Demonstrations (CFLDs), have contributed to notable gains in productivity, yield stabilization, and farmer income enhancement across several key states. Productivity improvements—rising by over 40% between 2010 and 2025—demonstrate the effectiveness of improved varieties, seed replacement, and better agronomic practices disseminated through extension mechanisms. However, despite these achievements, the persistent demand-supply gap and increasing edible oil imports highlight structural challenges, including regional disparities, climatic vulnerabilities, limited area expansion potential, and slower adoption of technologies in some states. The mixed state-level performance underscores the need for region-specific strategies, stronger extension outreach, climate-resilient varieties, and improved market and supply-chain integration. Overall, while oilseed development programmes have delivered measurable benefits, achieving long-term self-sufficiency will require sustained investment in innovation, adaptive policy support, and enhanced farmer capacity building to reduce import dependency and ensure sectoral sustainability.

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Authors' Contributions: Author 1 conceptualized the study, developed the methodology, collected the data, and drafted the initial manuscript. Author 2 supervised the research, critically reviewed the manuscript, and provided final approval for publication. Author 3 carried out the data analysis, interpreted the results, and contributed to manuscript revision.

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