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Crop diversification through oilseeds

for enhancing the productivity and profitability

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Indian agriculture is now facing second generation problems like rising or lowering of water-table, nutrient imbalance, soil degradation, resurgence of pests and diseases, environmental pollution and decline in farm profit. Crop diversification shows lot of promise in alleviating these problems. Crop diversification is recognized as one of the most environmentally feasible, cost-effective, and reasonable approaches to reduce uncertainty in agriculture. India's diverse agro-ecological 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. 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. Despite this positive growth, the country still falls short of meeting domestic demand of edible oil. Oilseed crops offer unique opportunities for industrial and edible uses of oil and have potential to spread to newer niches leading to crop diversification. Promoting oilseed crops and diversification in existing cropping systems and new niches in the country can have important nutritional benefits for farmers and support towards making self-reliant in terms of edible oil requirements besides promoting industrial applications and value addition.

Keywords: Crop diversification, Oilseeds, Rainfed agriculture

CROP diversification has been recognized as an effective strategy for achieving the objectives of food security, nutritional security, income growth, employment generation, judicious use of land and water resources, and sustainable agricultural development. The opportunities for crop diversification emerge from technological breakthroughs, changes in demand pattern, development of irrigation, availability of marketing infrastructure and new trade arrangements. The necessity for crop diversification arise on account of the need for reducing risks associated with yield, market and prices; arresting the degradation of natural resources and the environment; and attaining national goals like employment generation, self-reliance in critical crop products and for earning foreign exchange. Crop diversification also acts as a powerful tool in minimization of risk in farming. These considerations make a strong case for farm/crop diversification in India. Crop diversification and large number of crops are practiced in rainfed areas to reduce the risk factor of crop failures due to drought. The crop diversification also takes place due to government policies and thrust in some crops over a given time. For example, creation of Technology Mission on Oilseeds (TMO) to give thrust on oilseed production as a national need for country's requirement to reduce imports.

Need for crop diversification through oilseed crops

India's diverse agro-ecological 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 rainfed agriculture, with 76% of the oilseed cultivation area contributing 80% of total production.

Oilseeds account for 14.3% of the yearly gross cropped area. 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 oilseed production in the country. Among nine major oilseeds, soybean (34%), rapeseed & mustard (31%) and

groundnut (27%) contribute to more than 92% of total oilseeds production in the country. 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 tones (MT) in 2022-23, reflecting a significant increase of 3.39 MT compared to the previous year. However, despite this positive growth, the country still falls short of meeting domestic demand.

Currently, India is the world's top importer and second largest consumer country of edible oils in the world. During 2021-22, India imported 14.19 Mt of edible oils worth ₹ 1,66,427crores, which is 55% of its total requirement, in which palm oil commanded the largest share (57%), followed by soybean (29%) and sunflower (14%) oils. Achieving *Atmanirbharatha*/ self-sufficiency in edible oils through increasing area and productivity of oilseed crops and crop diversification with oilseeds is the need of the hour.

Sunflower, by virtue of its photo- insensitivity and wide adaptability to soil types, has a greater role to play in contingency cropping plans. It is suitable for late planting in *Kharif* in case of delayed rains. It can also be planted whenever the *kharif* planted crop fails due to failure of rains. Sesame has great potential as summer crop under limited irrigation in Telangana region of Andhra Pradesh. Good yields of soybean have been obtained from the crop grown in post-rainy season (*Rabi*/summer) in many states.

Soybean is ideally suited for vegetarian dominated Indian society. It is also called poor man's meat. It fits efficiently in cropping pattern replacing some efficient *kharif* crops. Also, energy rich crop such as groundnut, rapeseed and mustard, soybean, sunflower, castor, safflower, sesame, linseed and niger must find place in cropping systems.

Diversification of oilseeds in upland rice/rice fallow situation

Identifying newer areas and seasons for cultivation of oilseeds can help increase oilseeds production. Rice-fallows, especially in Eastern India, are the potential general areas for many oilseed crops like sunflower, rapeseed-mustard, groundnut and sesame. Oilseeds, being more salt tolerant than pulses and many cereals, have better chances of success in large tracts of saline areas. Likewise, under situations of limited water availability for the second crops of rice or in tail-end areas of canals, oilseed crops are better options. With less than a third of water needs of rice, a good crop of oilseed can be harvested. Wherever water resources are limiting such as tail end area of irrigation command, tank fed area and well irrigated areas, oilseed crops like groundnut, soybean, sunflower, sesame etc. can be profitably cultivated. In rice fallow situations of Cauvery deltaic areas of Tamil Nadu and Coastal Andhra Pradesh, sunflower and sesame can be profitably grown. In Tungabhadra Project areas of Karnataka and Andhra Pradesh, it is profitable to grow groundnut, sunflower and sesame under rice fallow situations. Groundnut has great potential under residual moisture after the harvest of *kharif* rice in coastal region of Karnataka and Andhra Pradesh. There is a great potential of *rabi*/ summer groundnut in rice fallows and on residual moisture in flood plains in Assam, West Bengal, Odisha and Chhattisgarh. Mustard has an excellent potential in rice fallows in North Eastern states. As a summer crop in Eastern states, sesame is profitably grown after rice. In the Upland areas of Odisha, Tamil Nadu, Bihar and Andhra Pradesh, groundnut (*Kharif)*, soybean and sunflower are more remunerative as compared to upland rice. Studies on agro-economic feasibility of oilseed crops in rice fallows demonstrated that the higher net returns and B:C ratio were accrued in the order of sesame > castor > groundnut > sunflower in southern Telangana. While in Northern Telangana zone, zero-till sunflower was successful. Rice-sunflower has emerged as a promising cropping system in Telangana (Nizamabad/Siddipet), West Bengal (South 24 Parganas) and Odisha.

Promoting oilseed crops through crop diversification

Sunflower in Nizamabad district of Telangana: Identifying the potential of sunflower in the region, ICAR–Indian Institute of Oilseeds Research (IIOR), Hyderabad, along with KVK and State Department of Agriculture officers, had demonstrated the best management practices with DRSH-1 hybrid in Hegdoli village of Nizamabad district during *rabi* seasons of 2017-2019. Other existing schemes of soil health cards and skill development training were converged. Supplying the needed P through SSP and directed spray of B @ 0.2% at ray floret opening stage, irrigation at critical stages (2 to 3 *vs*. 6 to 8 for maize), and minimal or need-based plant protection resulted in realizing a higher seed yield of 2,500-3,000 kg/ha (16-24% improvement) with high profitability at ₹ 45,000 - 60,000/acre in 100-105 days Thus, the area under sunflower expanded from about 400 ha in 2016 to more than 7000 ha in 2021-22 in the district. The irrigation water was also saved, including expenditure on electricity. Further, the beekeepers association was persuaded to introduce an apiary in Hegdoli village and 500 kg of pure sunflower honey was harvested in 3 weeks in the first batch. Observing the potential of the area, they started an apiary with 800 bee hive boxes in a large sunflower area of about 2,000 acres. Around 5200 kg of pure sunflower honey was harvested in a period of two months and sold @ ₹300/kg (Table 1) in the name of 'Honey Natural'. Apiary is a win-win situation for sunflower farmers and the village level entrepreneurs, whereby farmers perceived that the yield of sunflower increased by 20% due to honey bee activity and provided a sustainable livelihood to the local entrepreneur. This model can be replicated in rice-fallow areas and also to encourage agri-entrepreneurship through honey bee keeping and honey production.

Table 1. Economics of co-cultivation of honey bees with sunflower in Hegdoli village, Nizamabad, Telangana

Item	₹/kg	Total (₹/kg)
Honey yield/box (kg)	6 to 7	5200 Kg
Sale price of honey/kg	300	15,60,000
Net income (₹)		5,60,000

Introduction of summer sesame in cotton fallows: Adilabad district is one of the backward districts, located in the northern region of Telangana state. Traditionally, tribal farmers do cultivate cotton, soybean, redgram, during *kharif* in black cotton soils. Farmers with access to irrigation during *rabi* cultivate chickpea, fodder sorghum and wheat. Most of the farmers keep the land fallow after cotton. Of late, due to severe pink boll worm infestation, it is not profitable to extend the cotton crop after January. Provision and construction of new farm pond in the locality provided an opportunity to raise second and third crop. Summer sesame provides an opportunity as second crop after cotton. As a part of diversification activity, IIOR promoted safflower crop after harvesting soybean and planting summer sesame after cotton as a bonus crop. Castor crop was promoted as intercrop with redgram on-farm participatory research and demonstrations of summer sesame were conducted in Indravelly and Gudihatnoor mandals of Adilabad district, Telangana during 2021-2023. IIOR facilitated supply of critical inputs *viz.*, improved seed of sesame (Shwetha, JCS-1020, YLM-66), bio-fertilizers, inorganic fertilizers and need-based plant protection chemicals. The sesame crop was sown during second fortnight of January in line sowing and with recommended improved cultivation practices. Two irrigations were provided. On an average, 3 q/acre sesame seed was realized. Taking into account the current market, price of sesame seed as ₹ 10,000/quintal in local market, the gross returns realized were ₹30,000/acre and net returns ₹23,000/acre as a bonus crop for crop of 90 days duration. IIOR facilitated formation of tribal association which was registered as *Malkapur Kisan Vikaas Sangh* in District Cooperative Office, Adilabad with 35 members from Malkapur village. Non-availability of human labour was one of the major constraints of profitable crop production in study area. The resource poor tribal farmers with small holding had no access to farm implements. ICAR-IIOR facilitated procuring and supply of one mini oil expeller, 3 power weeders, 3 brush cutters, 5 battery operated sprayers and tarpaulins. Access to mini oil expeller has helped the members of association in extraction of vegetable oil of sesame and utilizing the pure oil for home consumption and the possibility for sale of edible oil to other members/non-members.

Intercropping safflower + chickpea (1:10) in Adilabad district through re-utilizing conserved water through farm ponds

Introduction of summer sesame (YLM-66) in Keslapur village, Adilabad district, Telangana

Promotion and hand-holding of tribal association by supplying oil expeller, power weeders and battery-operated sprayers under IIOR-TSP in Malkapur village, Adilabad district

Cultivation of linseed under utera conditions: *Utera* cropping is the sowing of the next crop seeds before harvesting of standing paddy crop in order to utilize moisture efficiently under rainfed agro-ecosystem. *Utera* cropping is only adopted in *rabi* season. The impact of improved *utera* on farmers' fields under AICRP (linseed) demonstrated that the improved technologies under *utera* condition increased the linseed yield by 33.5% and fetched an additional net income of ₹ 7252/ha with IBCR of 5.04 was obtained through improved *utera*.

Crop diversification strategies

The strategies for diversification of annual oilseed crops in the country have been proposed for area expansion and enhancing the productivity of the oilseed based production system with necessary institutional support/ handholding by state department of Agriculture and KVKS.

Increasing intercropping intensity to increase land-use efficiency and higher production from the same acreage

Extending to paddy and other fallows

- Sunflower and sesame in West Bengal and Eastern India
- Groundnut in paddy fallows, potato fallows, river basin in Odisha and West Bengal and Dessa in Gujarat

Extending to non-traditional areas and non-traditional seasons

- Spring sunflower in Indo-Gangetic Plain region, *rabi* sunflower in West Bengal, Odisha
- Spring groundnut in Uttar Pradesh
- Safflower in Chhattisgarh, Gujarat and Madhya Pradesh in *rabi* season
- Mustard in Andhra Pradesh, Telangana and Karnataka
- Soybean in Telangana
- *Rabi* castor in Telangana, Karnataka and Tamil Nadu; Castor in Haryana

Intercropping with major crops of the region

- Sunflower with groundnut, pigeonpea and soybean in Karnataka and Maharashtra
- Castor with groundnut, pigeonpea, cluster bean, mung bean in Telangana and Tamil Nadu
- Safflower with chickpea, coriander, *rabi* sorghum in Andhra Pradesh, Maharashtra, Karnataka, Madhya Pradesh, Chhattisgarh
- Linseed with wheat, chickpea in Uttar Pradesh, Madhya Pradesh, Gujarat, Rajasthan, Maharashtra
- Soybean with pigeonpea, maize, sorghum, cotton, sugarcane and orchards in Maharashtra, Telangana and Karnataka
- Groundnut with pigeonpea, cotton, pearl millet, cowpea, maize, sesame, castor, sugarcane and with plantation crops in Andhra Pradesh, Tamil Nadu, Karnataka, Uttar Pradesh (Bundel), Gujarat and Maharashtra
- Mustard with chickpea and lentil in Rajasthan, Uttar Pradesh and Madhya Pradesh

Successful cultivation of linseed under *utera* conditions in Nagpur

SUMMARY

India is endowed with diverse agro-ecological conditions. Such variations have led to the evolution of regional niches for the crops. Regions were often associated with the crops in which they specialize for various agronomic, climatic, hydro-ecological and even historical reasons. During green revolution phase for achieving food self-sufficiency, the cropped area and focus was more towards cereal crops. Under the changing climatic scenario, emerging new challenges and in the immediate aftermath of green revolution, the focus has to be shifted to non-cereal crops like oilseeds and pulses. There is a clear advantage of crop diversification with oilseeds in marginal eco-systems to make the cropping enterprise as a profitable venture avoiding risks as evidenced though successful examples in different agro-ecoregions of the country. Hence, crop diversification with oilseeds could be used as a tool for maximizing productivity, profitability leading to resource conservation. Given a desired policy frame work in place, oilseeds production can be increased to a limited extent by area expansion through replacement of non-remunerative crops, extension in rice fallows and problem areas, intercropping in widely spaced crops, as options in contingency planning, introduction in water scarce areas, diversification of rice-rice and rice-wheat systems, and by increasing competitiveness of oilseeds through value addition.

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