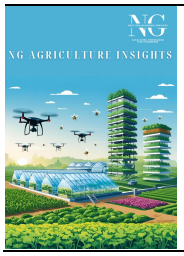

NG Agriculture Insights

A Popular Magazine (ISSN: 3107-5703)
Volume 2, Issue 5, September-October, 2026, 71- 78

Importance and Prospects of Oil Palm Cultivation in the North-Eastern Region of India

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A B S T R A C T

Oil palm (*Elaeis guineensis* L.) is a high-yielding perennial crop with considerable potential to reduce India's dependence on imported edible oils. It can produce about 4–5 t palm oil and 0.4–0.5 t palm kernel oil per hectare and remains productive for 25–30 years. The North Eastern Region (NER), with high rainfall, warm temperatures and suitable soils, offers favourable conditions for oil palm expansion. However, challenges such as poor infrastructure, limited processing facilities, difficult terrain, water management and competition from crops like rubber and arecanut need attention. Sustainable cultivation should focus on suitable land selection, soil conservation, drip irrigation, mulching, cover crops, and integrated nutrient and pest management. The National Mission on Edible Oils–Oil Palm (NMEO-OP), launched in 2021, provides important policy and financial support for planting material, price assurance and processing infrastructure. Cluster-based development, local-level surveys, intercropping during the juvenile stage and biodiversity-friendly agroforestry can further improve sustainability. With careful planning, oil palm can strengthen domestic oil production, improve farmer incomes and support rural development in the NER.

Keywords: *Oil palm, North East India, Edible Oil Self-Sufficiency, NMEO-OP, Sustainable Cultivation, Biomass By-Products, Agroforestry, Rural Livelihoods*

Submitted: 10-09-2026 Accepted: 19-09-2026 Online: 20-09-2026

1. INTRODUCTION

India is known for having greater diversity of oil seed crop due to its varied agro-climatic condition. India occupies a prominent place in global oilseeds scenario with 12-15% of area, 6-7% of vegetable oil production, and 9-10% of the total edible oil consumption and 13.6% of vegetable oil imports, but due to experiencing a widening gap between domestic oilseed production and the increasing demand for edible oils, the country heavily started importing of vegetable-oil to satisfy the needs of its growing population. The Government of India undertook several initiatives to enhance domestic vegetable-oil production. Among the major oilseed crops, oil palm has gained prominence as a promising option owing to its exceptionally high yield potential and greater profitability for farmers (Barman *et al.*, 2025). Oil-palm (*Elaeis guineensis* L.) having being originated in West and Central Africa spread throughout the world and in the present day the top three countries producing are Indonesia, Malaysia and Thailand. Palm oil, is

https://doi.org/10.5281/zenodo.22852228

extracted from the mesocarp (reddish pulp) of the fruit, that contains about 45–55% oil (FAO, 2023). It is considered as the major component for the current and future vegetable oil economy both in the world and in India, due to reduced cost price as a cooking essential (National Mission on Edible Oils, 2023). Two types of oil produced are Palm oil and Palm kernel oil. Palm oil is derived from fleshy mesocarp of the fruit, which contains about 45-55% of oil whereas, Palm kernel oil is obtained from the kernel of stony seed, is a potential source of lauric oil. Palm oil at present stands as world's most consumed edible oil as the crop requires lower cost of production compared to other oil crops. Oil Palm is one of the highest yielding edible oil crops first entered Indian sub-continent in Kolkata at National Royal Botanical Garden in the year 1886. Many years later, it spread out with the help of Maharashtra Association for Cultivation of Sciences (MACS), Pune during 1947–1959. The commercial cultivation of oil palm began between 1971 and 1984 was started for cultivation by small land holders in Kerala by the plantation corporation of Kerala Ltd and expanded to Little Andaman in 1976. In 1986, it launched the Technology Mission on Oilseeds, which included oil palm because of its exceptionally high productivity approximately 4.0–6.0 tonnes of crude palm oil and 0.4–0.6 tonnes of palm-kernel oil per hectare annually. In India, oil palm is primarily cultivated by smallholder farmers, while private companies purchase the harvested fresh fruit bunches according to a predetermined pricing formula. The respective state governments support and facilitate the expansion and development of oil-palm cultivation (Dass and Gulati, 2012). Later on, Institutional support from ICAR (AICRP on Palms), the Department of Agriculture & Cooperation (DAC), Department of Biotechnology (DBT), UNDP, and the Technology Mission on Oilseeds and Pulses (TMOP) played supporting roles in boosting up demonstrations, training, and seed production (KaliDas *et al.*, 2014). The consumption of edible oil in India accounts for 40% for palm oil compared to other countries. By the 1990s the India's goal to become self-reliant in edible oils has driven the state to rapidly increase domestic palm oil production to keep pace with a projected doubling of consumption over a 15-year span, though this growth is currently damaging ecologically vital, wildlife-rich ecosystems (Srinivasan *et al.*, 2021). About 9 million tonnes of palm oil every year is imported by India, spending about ₹40,000 crore, nearly 56% of its total edible oil imports (NMEO, 2022). This heavy reliance on imports of oil palm shows the country's dependency on palm oil to meet its requirement for rising edible oil demand, and it highlights to the urgent need to boost domestic production in order to reduce import costs and strengthen food security of India. The increasing use of palm oil underlines its economic importance, both because it is relatively cheap and because it plays a major role in the overall vegetable oil market. At present, oil palm is mainly grown in states such as Andhra Pradesh, Telangana, and Kerala account for 98% of total production while Karnataka, Tamil Nadu, Odisha, Gujarat and Mizoram also have a considerable area under Oil palm cultivation. Recently Arunachal Pradesh, Assam, Manipur and Nagaland have also started Oil palm plantation programmes. Though, North Eastern Region (NER) remains largely untapped. To date, approximately 337,000 ha has been brought under oil-palm cultivation, producing nearly 300,000 tonnes of palm oil. The harvested fresh fruit bunches (FFBs) are processed by 26 processing units across the country (Nasim Ali and Nagendra Rao, 2021). Oil palm has become a well-established plantation crop in India, and from the fourth year onward, progressive farmers can obtain FFB yields of about 20-25 tonnes per hectare annually. However, the NER's abundant rainfall, warm climate, and availability of land make it highly suitable for expanding oil palm cultivation. Promoting oil palm in this region could also bring important socio-economic benefits, including job creation, higher incomes for farmers, and overall rural development, making it a promising crop for the NER (Navyasree *et al.*, 2024).

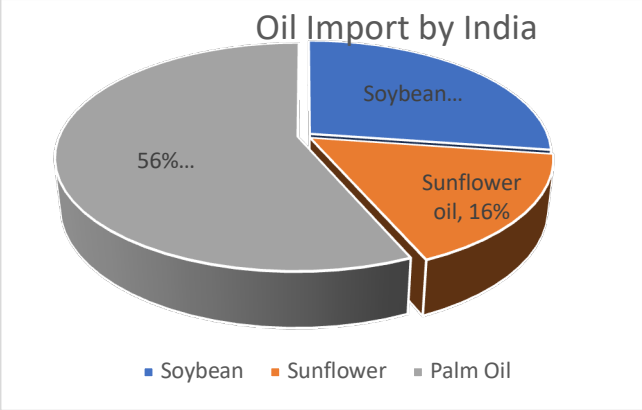

Figure 1. Percentage of different crop oil imported by India

2. AGRO-CLIMATIC AND SOIL REQUIREMENT FOR OIL-PALM

The Oil Palm is best suited for growing under optimum temperature of 22-24 ^{0}C and a mean maximum temperature of 29-33 ^{0}C and on an average sunlight of at least five hours/day. High humidity more than 80% is beneficial. It is a strong light demanding crop. Oil palm is considered a humid crop

and requires a 200 cm per annum of annual rainfall. The crop can tolerate two to four months of dry spell. Occasional water logging ca ne tolerated but frequent water logged, extremely sandy and hard lateritic soils should be avoided. The best suited soils for oil palm are moist, well-drained, deep loamy alluvial soils, rich in organic matter with good water permeability with pH of 5.0-7.5. Soils that are highly alkaline, highly saline, waterlogged and sandy soils are avoided for cultivation.

3. VARIETIES AND PLANTING MATERIAL

Three types of oil palm are used for cultivation for oil production and classified based on their shell thickness and oil percentage.

Dura- This are having thick shell upon fruit with low mesocarp and low oil. ***Pisifera***-Shell is absent and ring of fibre is present around the kernel. It may contain embryo or may be embryoless. ***Tenera***-This are hybrids of Dura and Pisifera. Shell is thin with fibre ring around the shell and superior oil yield is its main characteristics. India imports hybrid types from Indonesia and Malaysia.

For planting triangular system at 9 m x 9m x 9m is recommended and ideal planting season is June-October. During this time period, 12-15 months old saplings that are healthy and disease free are planted. Basically, seeds are extracted from fruits using deep pericarps and then seeds are heated at 40 ^{0}C for 80 days and soaked for 4 days in running water then kept in cool place. Germination basically commences after 10 days and the seedling is kept in polybags to raise seedlings that are supplied to farmer after 12 months or 15 months but the seedling height must be 1-1.3 m from base and 13 number of functional leaves must be present.

4. IRRIGATION AND NUTRIENT REQUIREMENT

On a monthly basis, 150-200 mm water is required and most suited irrigation system is drip irrigation. Application of 25-50 kg FYM/palm/year is effective whereas mulching or use of green manuring can be beneficial. N:P:K @ (2-3:1-1.5:3-4) kg/palm is required along with MgO @ 0.5-1 kg/palm.

5. INTERCULTURAL OPERATIONS

Cover crop with *Mucona* spp. or *Pueraria phaseoloites* L. are beneficial for improving soil structure and fertility. Sometimes intercropping is practiced for two and half years with banana, chilli, ginger, turmeric, pineapple, pulses etc. Pruning of dead leaves or diseased leaves is essential to maintain 36-40 functional leaves and facilitates air circulation. Ablation is carried out at one-three and half years old plant where male and female flower produced in the earlier stages are removed. It enables that plant to obtain stem gut at adequate rate and good root system develops and vigour is also developed. Flowering of the plant starts from 14-18 months. Pollination is carried out through wind or a species of weevil (*Elaeidobius kamerunicus* L.).

6. MAJOR PEST AND DISEASE

Rhinoceros beetle, red palm weevil, leaf eating caterpillar are mainly observed among insects whereas disease like Ganoderma stem rot, bud rot, leaf spot mainly occurs. Such can be controlled through cultural management or application of bio-control agents like *Trichoderma* spp. or *Beauveria* spp.

7. HARVESTING

Harvesting is carried out when fruit branches turn yellowish orange and 5-10 fruit drops on their own. The fruits when pressed if seems hard and release orange colour oil is an indicator of harvest ready. The stalk also must be 5 cm in length. Basically after 3-4 years of planting the first harvest is done but economic yield can be obtained from 5 years onwards. Harvesting is done every 7-10 days interval round the year. The peak yield is obtained at 7-9 years. The types of bunches are ripe bunches having yellowish orange colour and unripe bunches having black/purplish black colour. Malaysian knife is used for good harvest.

8. SUITABILITY OF OIL PALM IN NORTH-EAST REGION

The North-East part of India has varied agro-climatic condition. The average annual rainfall of this region is around 2000-3000 mm that is ideal for oil palm cultivation and have a temperature in the range of 25-30 ^{0}C. the soil is extremely fertile, deep and loamy soil with good organic content. Most of the North-East, apart from high-altitude Sikkim fulfils these climatic needs, particularly in the Brahmaputra and Barak valleys, adjacent foothills, and mid-elevation plateaus where deep alluvial and red loamy soils coincide with abundant, well-distributed rainfall. The sunshine hours in NER is also optimum for the crop. Some areas also face severe rainfall and through proper cultivation practices the crop can be grown but drainage facilities with adequate availability of water are required for best yield (Navyasree et al., 2024). Although, adoption of oil-palm in North-East may lead towards diversification in crop production that can promise increase in income level of the area. The higher yield regarding oil production that is 3-8 times more than

any other oilseed crops. Conversion of oil-palm kernels and biomass into animal feed and biofuels can bring more economy in the region. The utilization of palm-oil in food industry and local culinaries are very high and in coming years will increase further more. Not only in food industries, also its demand is high in cosmetic industries and if oil-palm cultivation can be established successfully, then the North-eastern region can lead the palm oil market boosting the economy of the country (Barcelos et al., 2015; GOI, 2021).

Table 1: Areas with potentiality for cultivation of Oil-palm in NER

States	Potential Areas (ha)	Districts Covered
Arunachal Pradesh	133,811	East Siang, Lower Siang, Kamle, Papumpare, Pakke Kesang, Lower Di bang Valley, Namsai, Tirap and Changlang
Assam	375,428	Kamrup, Goalpara and Dhemaji
Mizoram	66,792	Aizawl, Kolasib, Mamit, Serchhip, Lunglei, Lawngtlai and Saiha
Manipur	66,652	Bishnupur, Chandel, Churachandpur, Imphal west, Thoubal and Ukhrul
Meghalaya	122,637	Nil
Nagaland	51,297	Dimapur, Peren, Mokokchung, Wokha, Mon, Longleng and Kohima
Tripura	146,364	Unakoti and West-Tripura
Total	962,981	

Source: The National Mission on Edible Oils - Oil Palm, MA&FW, 2024

The points that can be take in consideration for establishing of oil palm in North-Eastern Region are as follows:

i) The labour demand for cultivation of oil palm is not so high and is quite manageable.

ii) Maintaining of palm oil crops is not so mind-tiring job regarding disease-pest. It is relatively simple to manage and thus makes it a low-effort choice for farmers.

iii) It is much more economically supporting for small and marginals land holders as it provides reliable monthly source of income after 4 years from planting for a long-term due to oil-palm's lifespan up to 25-30 years and its higher oil yield than other oil seed crops per hectare is also a key feature.

iv) Intercropping of other crops of short-duration is possible during early growing period of oil-palm.

v) Fallow or non-cropped land could be brought under utilization aiding in economic upliftment of farmers.

vi) The commercial sale of oil palm derivatives is highly organized and predictable.

vii) NMEO-OP mission by Government of India may act as a backbone for farmers and corporate sectors for successful initiation of Oil-pam plantation drive in the region. (Prasad *et al.,* 2025; Singh *et al.,* 2025).

9. CONSTRAINTS

The key constraints are- non-availability of infrastructure regarding irrigation facilities, transportation, road and markets, lack of oil extraction and processing mills as high capital cost required in setting up, vast land areas are under rubber cultivation and other community based agro-forestry practices or jhuming makes it difficult for bringing large areas under oil-palm cultivation. One of the major constraints of oil-palm is that, it needs to be processed within 24 hours from harvesting. Though the region faces wide distribution of rainfall throughout the year but in periods with low or deficit rainfall in a continuous period of time may affect the yield of the crop as oil-palm is a water-intensive crop requiring enormous supply of water for producing optimum yield. Moreover, the undulating terrain condition also acts as a barrier in mechanized planting. Competition from other economically viable crops such as rubber, arecanut, sugarcane, banana, pineapple, coconut etc majorly cultivated in this region due to the regions suitable agro-climatic condition for such crops is a serious issue. For managing a large farm, huge quantity of manures and fertilizers are required and instant availability of manures in large quantities require on-farm production or availability in local markets. Lack of mechanical harvesting equipment/tools in the hand of farmers in some regions of north-east may affect the harvesting period. Farmers are discouraged when the government delays, reduces, or entirely stops the payment of promised subsidies, and when procurement is delayed or the procurement price is lowered on quality grounds and differences in import duty on edible oils. (Navyasree et al., 2024; Down to Earth, 2026).

10. STEPS TOWARD SUSTAINABLE OIL PALM PRODUCTION

To enhance the sustainability of oil palm cultivation and produce more sustainable palm oil, greater emphasis must be placed on key factors such as land selection, soil conservation, efficient water management, and maintaining a suitable growing environment.

10.1 Land selection as a priority

Choosing appropriate land is the most critical step for successful and sustainable oil palm cultivation. Ideal soils are those with good water infiltration capacity, low-lying topography, and reliable water availability. In contrast, wetlands and deep black cotton soils are unsuitable for long-term sustainable production.

10.2 Evidence from successful regions

The success of oil palm cultivation in South Indian states largely attributed to the use of red and light-textured soils has guided the selection of similar agro-ecological zones in other states, including Gujarat, Odisha, Chhattisgarh, and north-eastern states such as Mizoram and Arunachal Pradesh.

10.3 Suitable areas identified across India

Healthy and high-yielding oil palm growth has been observed in several locations, confirming their suitability and sustainability for cultivation:

- Tripura: Nagicherra and Baspadua
- Arunachal Pradesh: Lower Dibang Valley and Pasighat
- Mizoram: Aizawl and Kolasib
- Gujarat: Navsari and Valsad
- Chhattisgarh: Jagdalpur and Bijapur
- West Bengal: Gosaba wetlands in the Sunderbans

These regions demonstrate that when land selection aligns with soil and water requirements, oil palm can be grown sustainably with productive outcomes.

10.4 Ways for achieving sustainability in oil palm cultivation

Sustainable oil palm production depends on careful management of soil, water, and crop health. When these practices are followed systematically, oil palm cultivation becomes more environmentally sound, socially responsible, and capable of delivering sustainable yields.

10.5 Soil health management

Protecting and improving soil health is central to sustainability. Key soil conservation measures include little or no tillage, contour ploughing, terracing, and the use of cover crops to prevent erosion and maintain soil structure. Four guiding principles should be followed:

- Minimum soil disturbance: Avoid or reduce tillage operations.
- Maximum soil cover: Keep the soil surface covered with vegetation or residues.
- Maximum biodiversity: Grow cover crops and intercrops to support diverse organisms.
- Continuous living roots: Maintain living roots in the soil as much as possible.

Excessive tillage degrades soil and reduces organic matter, so it should be minimized. Cover crops and intercrops not only protect the soil but also enhance biodiversity, support ecological balance, and reduce habitat loss. Since these practices are already being adopted in Indian oil palm–growing regions, they contribute significantly to sustainable palm oil production.

10.6 Water management

Oil palm is relatively water-efficient. It requires about 1,875 litres of water to produce 1 kg of oil, which is far less than crops like soybean (7,000 L), olive (17,312 L), cotton (22,500 L), sugarcane (1,500-2,500 L), and rice (3,000-5,000 L). Its water-use efficiency is also high, generating around ₹8 for every 100 litres of water used better than most other major crops. To further improve sustainability, water use should be optimized through efficient irrigation systems such as drip, micro-jet, or precision sprinklers. Water-conserving practices like mulching help reduce evaporation, suppress weeds, and retain soil moisture, thereby enhancing overall water-use efficiency.

10.7 Crop management

Sustainable crop management includes adopting Integrated Pest and Disease Management (IPDM) strategies. This involves reducing reliance on synthetic chemical pesticides and promoting biological control methods, such as parasitoids and microbial agents, to manage pests effectively and ecologically. Responsible nutrient management is equally important. Fertilizer application should be based on soil test recommendations to avoid overuse. Incorporating organic manures and biofertilizers improves soil fertility, reduces dependence on synthetic fertilizers, and supports long-term productivity. When these soil, water, and crop management practices are applied systematically in farmers' fields, oil palm cultivation becomes more sustainable, environmentally friendly, and socially responsible, ultimately leading to the production of sustainable palm oil. (Potineni, 2023,

https://c4rb.org/sustainable-production-of-palm-oil-in-india/)

11. IMPACT OF OIL-PALM CULTIVATION IN NORTH-EAST INDIA

i) As it is a water-intensive crop, the water table may deplete that may bring imbalance in the biodiversity.
ii) Disturbance in natural eco-system that may disturb the harmony between humans and animals.
iii) Loss of natural forest cover and conversion of shifting cultivation lands to oil-palm growing areas may affect the food habit of the people residing in sloppy lands.
iv) Erosion of soil due to heavy rain may pose a serious threat in undulating lands and changes in soil chemical properties may occur.
v) It takes around 3-4 years from planting to fruiting, in this wide-gap the farmer needs to cultivate other crops between the plantation area for maintaining their livelihood.

12. BY-PRODUCTS IN OIL PALM PROCESSING UNIT

Mainly 3 raw products could be produced from palm nuts viz., empty fruit bunches, palm kernel shell and mesocarp fibre. Empty fruit bunches (EFB)- The fibrous structures that support the fruits on the oil palm are valuable biomass by-products generated during palm oil extraction. After drying to reduce moisture, EFB becomes an effective fuel capable of achieving adequate combustion temperatures. These bunches can be recycled to fire steam boilers, where the resulting steam drives turbines for electricity generation. This sustainable practice enhances resource efficiency and supports renewable energy production. Palm kernel shells (PKS)- The shell fractions left after the kernel is extracted from the seed for oil production. They occur in a range of sizes and textures from large, fibrous, and bulky pieces to fine, dust-like particles. When blended, these shells form a high-quality biomass fuel with low moisture, which is easy to handle and store. Like empty fruit bunches (EFB), PKS can be compressed into solid fuels and used to fire steam boilers for electricity generation. Mesocarp fibres (MF)- They are the dry, fibrous residue left after oil palm fruits are pressed to extract palm oil. This fibrous "cake" has multiple applications: it can be processed into fertilizer, used to manufacture fibre boards and blackboards, and serve as a base material for fatty-acid-based animal feed. (Singh *et al.,* 2025).

13. GOVERNMENT POLICIES AND INITIATIVES

The expansion of Oil-palm in North-east India by the GOI is basically through the National Mission on Edible Oils-Oil Palm (NMEO-OP) which allotted Rs. 5850 crores under 90:10 funding ratio. The mission was launched in 2021 in the month of August to boost edible oil production and to minimize the import of edible oil from foreign countries (NMEO-OP, 2022). The final one is to increase consumer awareness to maintain consumption level of 19.00 kg/person/annum till 2025-26. The major focus of this mission is to establish garden for increasing seedlings and nurseries for easy access of the farmers in getting planting materials from the state itself. More areas are to brough under drip irrigation, introduction of crop diversification initiatives, inter-cropping during the period between planting oil-palm and fruit bunch production with pulses, pineapples to aid income to the farmers, improving production of fresh fruit bunches, enabling the farmers to access economic return. To support expansion, 47 nurseries have already been established, while 22 more have been approved. Seed gardens are also being strengthened in Mizoram, Tripura, Arunachal Pradesh, Nagaland, and Assam. Processing infrastructure has improved with two operational mills in Arunachal Pradesh and one in Mizoram, while another mill has been approved for Assam. Overall, the Mission aims to increase area coverage, ensure the timely supply of quality planting materials, and develop processing facilities for the benefit of farmers across the North Eastern Region for which the government declared to provide capital assistance of ₹5 crore per 5 MT/hour processing unit (with pro-rata increases for larger mills) to attract private mills in the remote areas of the states. This mission has two focus areas:

i) The price of oil produced from the fresh fruit bunches are according to the International Crude Palm Oil prices. So, the GOI is proving price assurance to the farmers regarding this matter which is called Viability Price so that in case of any fluctuation of price of the international CPO, the Indian Oil-palm farmers doesnot face any economic loss.
ii) The GOI aims to increase assistance regarding the inputs/interventions. Another increase has been carried out for maintenance of oil-palm trees and inter-cropping interventions. From Rs. 12000 to Rs. 29000 per ha is increased regarding planting materials by GOI to bring more farmers under oil-palm cultivation and support the existing farmers for their betterment. A support of Rs. 250/plant is aided for

rejuvenation of the old gardens. (NMEO-OP, 2022;Ministry of Development of North-East Region, 2025)

14. INTERVENTIONS BY PRIVATE SECTORS

MoU have been signed by the respective state governments with 3 corporate industries for upliftment of oil-palm cultivation across the North-Eastern states. Godrej Agrovet Limited is one of the major investors in this region working in Assam, Tripura, Manipur and Nagaland. The second is Patanjali Food Limited mainly active in Tripura, Assam, Nagaland and Arunachal Pradesh. The last corporate industry is 3F Oil Palm Pvt Ltd & KE Cultivation working in local levels across Assam and Arunachal Pradesh (MA&FW, PIB 2023).

15. CONCLUSION

Oil palm is a high-yielding crop that can produce 25-30 t/ha of fresh fruit bunches after five years, yielding 4-5 t palm oil and 0.4-0.5 t palm kernel oil about five times more than traditional oilseeds and remains productive for around 30 years. India's North East Region has strong potential for oil palm due to its favourable climate and land availability, which could enhance edible oil self-sufficiency, create jobs, and support rural development. Realizing this potential depends on improving infrastructure, water management (e.g., rainwater harvesting and efficient irrigation), market access, and supportive policies to ensure sustainable growth and reduce import dependence. Taking into account optimal practices in land use, fostering agroforestry systems, and assuring the preservation of biodiversity will be beneficial to ensuring that cultivation of oil palm adds emphatically to the economy and the environment. On the other hand, environmental sustainability must be the key focus while planning of policies. To promote oil palm in the North East, coordinated policy, administrative, technical, and financial support is needed. With steady, year-round income, oil palm can reduce jhum cultivation and farmers' reliance on external credit. Implementation should begin with grassroots micro-surveys to identify suitable clusters, develop basic infrastructure, and sensitize project staff before encouraging crop diversification. Through NMEO-OP, oil palm can create sustainable employment, enhance livelihood security, boost domestic edible oil production, and advance Atmanirbhar Bharat in vegetable oils.

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