History and impact of Oil Palm cultivation in southeastern Asia and India

Introduction

Throughout the world, there are around 42 countries that produce palm oil. Indonesia and Malaysia produce over 85% of global palm oil supply (WWF). These major palm oil producing countries lie in Asia. The continent of Asia is rich in biodiversity, but also faces the highest threat of deforestation and habitat loss. The expanding oil palm plantations are a major cause of habitat loss, particularly in the tropical countries (Koh 2011).

Palm oil is considered to be an efficient crop with high global returns (Goh 2016). To meet the rising global demand for palm oil throughout the world, palm oil plantations are being expanded in the major palm producing countries such as Indonesia, Malaysia and Thailand (Dallinger 2011; Wicke et al. 2011). In order to be self-reliant, countries such as India are trying to expand their palm oil plantations as well (Mathur 2021). This expansion comes at the cost of harmful effects such as wildfires (Hope et al. 2005), landslides (Sidle et al. 2006), reduction in water quality (Comte et al. 2015), reduction in soil fertility (Hedin et al. 2009), carbon loss from vegetation (Gibbs et al. 2007), and impacts on indigenous populations (Obidzinski et al. 2012).

In this paper, we look at the situation of Oil Palm expansion in different Asian countries and understand the effects these expansions have had on them and what India can infer from it.

History of Palm Oil and its Introduction to the World

Palm oil (from the African Palm *Elaeis guineensis*) can be traced back to more than 5,000 years ago. Palm oil was long recognized in western African countries. It is used widely among western African people as cooking oil. In the 17th century, European merchants traded with western Africa and occasionally purchased palm oil for use in Europe, but as the oil was bulky and cheap, and due to the much higher profits available from slave-trading, palm oil remained rare outside western Africa.

During the early 19th century, the decline of the Atlantic slave trade and Europe's demand for legitimate commerce (trade in material goods rather than human lives) obliged African countries to seek new sources of trade revenue. In the Asante Confederacy, state-owned slaves built large plantations of palm oil trees, while in the neighbouring Kingdom of Dahomey, King Ghezo passed a law in 1856 forbidding his subjects from cutting down palm oil trees. Palm oil became a highly sought-after commodity by British traders, the oil being used as industrial lubricant for the machines of Britain's ongoing Industrial Revolution, as well as forming the basis for various brands of soap such as Palmolive. By 1870, palm oil constituted the primary export of some West African countries such as Ghana and Nigeria. By the 1880s, cocoa had become more highly sought-after, leading to the decline of the palm oil industry and trade within these countries.

The oil palm *Elaeis guineensis* is not native to Malaysia. Palm oil was first introduced to Malaysia (then Malaya) in 1870 as an ornamental plant. Its use as a crop was developed in 1917 when the first plantation was established. Then the palm oil plantations were mostly operated by English landowners. From the 1960's a major palm oil plantation scheme was introduced by the government mainly to eradicate poverty. Each settler was allocated 10 acres of land planted either with palm oil or rubber, and they were given 20 years to pay off the land.

India

Areas under palm oil cultivation in India

Andhra Pradesh, Goa, Karnataka, Assam, Kerala, Gujarat, Tamil Nadu, Maharashtra, Mizoram, Tripura, West Bengal, Telangana, and some areas of Andaman are on the list of palm oil cultivation in India. Out of these, Andhra Pradesh, Goa, Karnataka, Kerala, Mizoram, Tamil Nadu, Telangana are the States that share the maximum production of Crude Palm Oil (CPO) in India in the past five years.

Varieties of Oil Palm in India

There are 3 major varieties of oil palms available. These are -

1. Tenera: this variety is the ruling hybrid type and basically is a cross of shell-less Pisifera (female) and thick-shelled Dura (male). This variety has thin shells and is cultivated across the globe.
2. Dura: this variety is not commercially cultivated and it has a thick shell of 2–8 mm.
3. Pisifera: this is a shell-less fruit-bearing variety.

In India, 94.1% of its palm oil imports are used in food products, especially as basic cooking oil (Sagar et al. 2019). It is well-established that India is looking to reduce its dependence on palm oil imports from Indonesia, Malaysia, and others by cultivating its own palm oil plantations. This comes at a huge ecological cost. Government support in the form of subsidies is made available to farmers. Up to 85% of seedling costs and 50% on irrigation, chemical inputs, and processing costs (Srinivasan & Velho 2018). Kerala has two accessions of American Oil Palm *Elaeis oleifera* which were introduced from Malaysia and Costa Rica and planted at Palode, near the capital city of Thiruvananthapuram (Pedapati et al. 2013).

According to Mongabay, Kerala plans to double its palm oil cultivation in the next four years, as it just has one processing unit located in the southern area of the state (Joseph 2021). Oil palm cultivation is considered a threat to biodiversity if expanded in northeastern India, especially considering the fact that northeastern India and the Himalaya are one among the biodiversity hotspots in the world. The palm oil plantation in these regions is also harmful considering the 'land use change' policy,

According to Srinivasan et al. (2021), India has the potential to grow and expand its oil palm cultivation in certain areas without affecting biodiversity. They have estimated 7.86–38.8 Mha of land for palm oil cultivation. But this would require different compromises such as the conversion of marginal paddy fields to palm oil cultivations if biodiversity is to be spared.

Effects of Palm Oil cultivation on biodiversity in other Asian countries

Malaysia (Mainland)

Malaysia is the largest exporter of palm oil in the world, producing about 15 million tonnes of palm oil a year. It ranks next to Indonesia at 19,516 thousand tonnes of palm oil produced every year (FAO 2018). Palm oil production in Malaysia has increased significantly from 10.8 million tonnes in 2000 to 19.8 million tonnes in 2020 (FAOSTAT 2020). It now accounts for approximately 47% of global palm oil production and 54% of world exports. As one of the biggest producers and exporters of palm oil and palm oil products, Malaysia has been playing an important role to satisfy the international demand and to stay competitive in the world's oils and fats market. In 2004,

Malaysia produced nearly 14 million tonnes of palm oil, from its mere 3.8 million ha of plantation area. This has contributed to more than 1/3 of the agricultural GDP or 2.9% of the national GDP. The sector has become one of the most crucial foreign exchange earners for Malaysia. The current total forest area per total land area in Malaysia is 58.17%. There is a significant increase in the proportion of forest areas under legally established protected areas at 17.63% from 9.43% in 2000 (FAOSTAT 2020). However, the palm oil industry plays a crucial role in Malaysia's economy and livelihood. To increase palm oil production, palm oil plantations are increased. Palm oil plantations are known to be one of the leading causes of deforestation (Wilcove & Koh 2010). In Malaysia, the expanding palm oil production not only causes deforestation, but the burning of lands to make space for palm oil plantations threatens its peatlands (Evers et al. 2017; Jaafar et al. 2020). A study by Garrity et al. (1996) through the presence of *Imperata cylindrica* showed there is a large number of degraded land in Malaysia, as the plant Imperata invades and establishes the degraded lands.

In Peninsular Malaysia, Johor has the largest area of land (745,630 ha) planted with oil palms followed closely by Pahang (732,052 ha). According to Wicke et al. (2011), the loss of forest cover in Malaysia varies per region. In recent years, forest cover has been affected most by the conversion of forest lands to agricultural land and oil palm plantations. According to McMorrow & Talip (2001), such distinctive change in Malaysia is due to the autonomy of Malaysian states when it comes to land use and resource policies. Although there is relatively less deforestation compared to Indonesia, there has been a sharp increase in land use for oil palm cultivation in Malaysia (Wicke et al. 2011).

The oil palm plantation also threatens the peatlands of Malaysia which are home to highly diverse flora and fauna. According to Evers et al. (2016), the biodiversity in the peatlands of Malaysia includes an array of uniquely adapted taxa including more than 200 freshwater fish species (Posa et al. 2011) many of which (more than 102 species) are stenotopic and found nowhere else (Giam et al. 2012), such as Paedocypris progenetica, the smallest known vertebrate in the world (Kottelat et al. 2006). These habitats are also important habitats for a range of endangered large and charismatic fauna (Posa et al. 2011). These peat forests are

also important for the Proboscis Monkeys, the flat-headed cat, Sunda Clouded Leopard, the Marbled Cat, and the Sumatran Tiger, as well as being the preferential habitat of the endangered False Gharial (Cheyne et al. 2009; Wibisono & Pusparini 2010).

To reduce the negative effects of oil palm plantations on biodiversity, there have been attempts to make palm oil cultivation more sustainable. But few studies have shown that this is not achievable easily. In a review paper by Tang & Al Qahtani, they report that oil palm plantations in Malaysia fall short of sustainability. A study done by Edwards et al. (2010) found that the abundance of imperilled bird species was 60 times lower in fragments and 200 times lower in oil palm plantations than in contiguous forests. Thus proving that the idea of forest-friendly plantations does not actually work. Rather, the focus must be given to keeping the existing forests contiguous.

Borneo (Malaysia)

Land Areas: 743,330 km^2 (287,000 square miles, 74.33 million ha, or 183.68 million acres).
Human Population: 17.7 million, of which 17% or 2.2 million is indigenous Dayak.
Countries:
• Malaysia (states of Sabah and Sarawak) (26.7%)
• Brunei (Sultanate) (0.6%)
• Indonesia (Kalimantan - West, Central, South, and East) (72.6%)

The third-largest island in the world, Borneo, originally had a thick canopy of rainforests. A large portion of the region was nearly inaccessible and undeveloped, with hilly interior and marshy coastal parts surrounded by mangrove forests. Up until a century ago, headhunters governed the island's interior. Borneo saw a dramatic transformation between the 1980s and the 1990s. At a rate never before seen in human history, its woods were destroyed. The jungles of Borneo were used to make garden furniture, paper pulp, and chopsticks that were exported to developed nations like Japan and the United States.

The world's most prolific oil seed is the oil palm. When cultivated in huge plantations, a hectare of oil palm may produce 5,000 kg of crude oil, or about 6,000 litres of petroleum, making the product incredibly profitable. Large areas of land are being transformed for oil palm plantations as a result. More than 8.6 million ha of oil palm were cultivated in Indonesia in 2015, up from 600,000 ha in 1985 (FAOSTAT 2020).

Peat fires started for land clearance have also had a significant negative impact on Borneo, particularly Kalimantan. Over the past 30 years, millions of hectares of peat, brush, degraded forest, and rainforest have burned to the ground.

Some types of land in Borneo are:
Mangroves - Mangroves are found in estuaries and coastal regions. These are estimated to cover around 1 million hectares in Borneo, a small fraction of their original extent due to conversion for agriculture.

Peat swamp forests - Swamp forests appear in places where dead vegetation becomes waterlogged and too wet to decompose, hence, they accumulate as peat.

Montane forests - Montane forests are generally found at an elevation from 900 m to 3,300 m in Borneo. Trees in these forests are typically shorter than those of lowland forest, resulting in a less-developed forest canopy. Langner & Siegert (2005) estimate that in 2002, about 70 percent (1.6 million ha) of Borneo's original montane forests (2.27 million hectares) remained.

Heath forests - These forests are characterised by certain tree species tolerant of the poor, acidic soil conditions and are considerably "stunted" in comparison with typical rainforests. Heath forests are also less diverse than the other tropical plant communities. MacKinnon et al. (1997) estimate that Borneo was once covered with 6,688,200 ha of heath forests. Today this area is so diminished, the World Bank estimates that almost no heath forests will remain in Borneo by 2010.

Dipterocar forests- Lowland Dipterocarp forests are the most biodiverse and most threatened forests in Borneo. These giant trees, often exceeding 45 m in height, are the most valuable source of timber in Borneo and have been heavily logged since the 1970s. Langner & Siegert (2005) estimated that just under 30 million ha of lowland dipterocarp forest remained in Borneo in 2002.

In Borneo, interest in oil palm farms started to grow as valuable timber became harder to find. Even though the first oil palm trees were planted in Indonesia in 1848, it wasn't until the mid-1990s that the industry truly began to take off. Oil palm plantations expanded in Malaysia, which is currently the world's largest producer of palm oil, from 60,000 ha in 1960 to more than 3 million ha in 2001. In 2004, 13% of these were in Sarawak, and 30% were in Sabah, where the plant may thrive in perfect circumstances. However, due to Peninsular Malaysia's extensive usage of suitable land, development is anticipated to take place mostly in Kalimantan and Malaysian Borneo. In Sabah and Sarawak, oil palm agriculture has expanded from 186,744 ha in 1984 to 1,673,721 hectares by the end of 2003. Oil palm cultivation has grown even more quickly in Kalimantan, from 13,140 ha in 1984 to around one million hectares at the end of 2003.

Oil palm is a low-risk venture for big estate owners because of its minimal maintenance requirements, expanding demand, and lack of other viable economic choices in the area, despite the fact that much of the new land brought under cultivation is not optimal for the crop. Subsidies that help large plantation owners include those for crude processing facilities and roads. The fruit of the palm tree, which may weigh 40 to 50 kg in clusters, is used to make palm oil. A single hectare of oil palm may generate 5,000 kg of crude oil, or approximately 6,000 litres of crude oil that can be used to make biodiesel, as opposed to 100 kg of oil seeds, which normally yield 20 kg of oil.

Borneo was seldom ever inhabited by people for the most of its history. Populations were tiny and dispersed due to the harsh environment and thick jungle. This has all altered in the last fifty years. The population of Borneo has doubled as a result of the more than 500,000 transmigrant arrivals over the previous 30 years, and there is now a huge labour shortage. When the forestry and rubber industries failed in the

middle (Malaysia) to late 1990s (Kalimantan), job possibilities for the majority of the local population dried up. Despite this, Borneo continued to see hundreds of fresh visitors each week. In Borneo in the late 1990s and early 2000s, rising unemployment was a major worry, and ethnic strife was raging in several areas of Kalimantan at the same time. Many locals and governments viewed the quick rise of the oil palm in the late 1990s and early 2000s as a welcome opportunity. The entire price of the sector's quick expansion is just now becoming apparent to observers.

Environmental Impacts

Beyond the obvious deforestation that results from clearing lowland rainforest for plantations (86 percent of deforestation in Malaysia from 1995–2000 was for oil palm plantations), there are other environmental impacts of oil palm cultivation. Several studies have found a significant reduction (on the order of 80% for plants and 80–90% for mammals, birds, and reptiles) in biological diversity following forest conversion to oil palm plantation. Further, many animals will not move through plantations while others, like orangutans, become crop pests putting them at risk of defensive poaching by plantation managers. The use of herbicides and pesticides can also impact species composition and pollute local waterways.

Drainage systems required for plantations (oil palm plantations in Borneo are often established in swamp forest) may lower water tables, affecting neighbouring forest areas. Further, destruction of peat lands increases the risk of flooding and fire. Land-clearing fires set by large oil palm plantation owners were the single largest cause of the massive 1997–1998 fires in Borneo.

According to current research, eating palm oil poses the biggest damage to the greatest number of species. A few species, such as palm civets, rats, and leopard cats, may thrive in monocultures, but the vast majority of rainforest species—more than 80% when compared to intact forest—are forced to find other habitats or perish. The cause? By eradicating the canopy, ruining intricate nutrient cycle systems, and converting clear-flowing streams into filthy receptacles for fertilisers, pesticides, and industrial chemicals, conversion to oil palm destroys entire niches in the forest. The industrialization of palm oil threatens many rare species, including the fishing cat and the flat-headed cat, whose only habitat is the swampy lowlands of Peninsular Malaysia, Borneo, and Sumatra. These two species are so rare that Jim Sanderson, the foremost expert on small cats, has only seen photographs of one and three individuals in the wild, respectively.

Four of Borneo's five cat species are vulnerable or endangered, Palm oil is the greatest threat to their survival. The rising demand for palm oil is also harming Borneo's "pygmy" elephants, who are called that because they are smaller than the elephants found in mainland Asia. The number of elephants harmed by snares set by plantation workers trying to augment their income by selling boar and deer meat to restaurants or eating it themselves has increased, according to the Sabah Wildlife Department, which maintains parks in the state of Sabah in Malaysian Borneo. Elephants fall into the traps and get caught in them. The ensuing wound may get infected

and potentially end in death of the animal. At Nyaru Menteng in Kalimantan, in the centre of Indonesian Borneo, the consequences of palm oil growth on orangutans are particularly evident. For the simple reason that appropriate habitat in Borneo is being deforested so quickly that it is becoming more and more difficult to identify areas for reintroduction, Nyaru Menteng is now more like a sanctuary rather than the rehabilitation centre it was designed to be. Study of the community of ground-dwelling ants in different plantations in Sabah, Malaysia, over two years using tuna baiting, revealed that the oil palm plantation ground ant community was severely reduced in species richness in comparison to the forest interior, regardless of age, undergrowth cover, or proximity to neighbouring forest.

Oil palm development has had an adverse effect on some of Asia's most iconic and endangered species, including Sumatran rhinos, tigers, Borneo pygmy elephants, small cats, and the well-known red ape, the orangutan.

Indonesia

Palm oil cultivation is on the rise, and Indonesia boasts the highest production of palm oil with Malaysia in the entire world, around 85% (Orangutan Foundation International 2022). Among these, 96% of Indonesia's palm oil comes from the islands of Borneo and Sumatra. Although most of it is grown commercially for international export, palm oil has also replaced coconut oil, which was traditionally used for cooking in Indonesia and contributes to 11% of the country's export earnings (Orangutan Foundation International 2022). Sumatra is the 6th largest island in the world and is home to a vast range of biodiversity, many of which are endemic to Sumatra and are highly threatened based on the IUCN Red List. Also, it is the only place in the world where orangutans, elephants, tigers and rhinos live together. Sumatra and Borneo primarily have peat land and get heavy rains, which is ideal for growing palm. The palm oil cultivation is done on primary forest lands instead of degraded lands of grasslands as it requires less maintenance and economic investments like that of fertilisers, etc. Also, as the forests are cleared by fire, the ash acts as good fertiliser for the land, but at the same time, it creates massive air pollution and carbon deposition through the swamps (Orangutan Foundation International 2022).

Sumatra is home to rare and distinct species like the Sumatran Orangutan *Pongo abelii* (CR), Sumatran Elephant *Elephas Maximus Sumatranus* (CR), Bornean Pygmy Elephant *Elephas maximus borneensis* (EN), Sumatran Tiger *Panthera tigris sumatrae* (CR), Sumatran Rhinoceros *Dicerorhinus sumatrensis* (CR), Sunda Clouded Leopard *Neofelis diardi* (VU), Sunda Pangolin - *Manis javanica* (CR), Crested Black Macaque - *Macaca nigra* (CR), and Malayan Tapir - *Tapirus indicus* (EN) (Palm Oil Investigations, n.d.). This list also includes the newly discovered Tapanuli Orangutan - *Pongo tapanuliensis* (CR), which was discovered in 2017 on Sumatra Island. Proboscis monkey, sun bear, flying fox bat are some of the 201 mammals, 580 bird species and around 15,000 known plant species found there (WWF 2020).

In the past 22 years, Sumatra has lost 50% of its forest cover, which is around 12 million hectares of forest (WWF 2020). Most of this

forest is cut down to get land for growing palm oil to meet its global demand. This leads to habitat loss for forest dwelling species, hence making them susceptible to poachers, forcing these animals to come to cultivation, farms and civilizations for food and increasing human – wildlife negative interactions. Many threatened charismatic species are endemic to either Sunda or just Borneo and/or Sumatra. There are only around 300 Sumatran Rhinos, less than 400 Sumatran Tigers, around 1,600 Bornean Pygmy Elephants (smallest elephant subspecies), 2,500 Sumatran Elephant and all of the 6,000 Sumatran Orangutans living in the wild found on the island of Sumatra (Palm Oil Investigations, n.d.). Due to habitat loss by deforestation for palm oil, these animals are either killed or exported for various purposes.

Orangutans are exported globally under exotic pet trade or are killed as pests by locals when they come to their farms for food (Palm Oil Investigations, n.d.). For Sumatran Tigers, elephants and rhinos, even today poaching remains the main threat, but habitat loss to palm oil has made them more prone to poachers. Sometimes, even locals kill these animals (e.g., elephants) to prevent them from coming near human settlements and farms and also take out their tusks to make it look like the work of poachers (Tropical Conservation Fund, n.d.). All these things together make it difficult to conserve these species as habitat once lost, cannot be reversed. Even though National Action Plan for Sustainable Palm Oil was implemented in 2019, and has developed three provincial platforms in Riau, northern Sumatra, and western Kalimantan, and three district platforms in Sintang, South Tapanuli and Pelalawan, species habitat once lost, cannot be restored by any afforestation methods (UNDP 2022).

Thailand

Thailand is one of the major oil palm producers in the world. Located in the Indo-Burma biodiversity hotspot, the country contains high species richness. A study by Jaroenkietkajorn et al. (2021) was done on the impacts of oil palm plantations on bird and insect species from land use in five regions of Thailand. Data from Global Biodiversity Information Facility (GBIF) and Thailand's Land Development Department (LDD) were used for species occurrence and land use data, respectively.

As per the study, bird and insect species were considered as an adequate representation for other animal species affected by oil palm plantations in Thailand. It concluded that impacts like water scarcity, soil degradation, among biodiversity loss were a direct result of deforestation to cultivate palm oil. Land-use change caused destruction in habitats with endemic species left in the lurch. Local and regional characterization factors were used to estimate environmental impacts.

Local characterization factors based on site comparisons and taxon affinities for specific land use types were estimated for each forest type. The regional characterization factors considering the wider landscape also depended on the local factors. With regard to species density, the differences between forests and ageing oil palm plantations are higher than between forests and all oil palm plantations. The study found that species density decreases with the age of

plantations. Also, the differences are higher for birds than for insects. However, this could also be due to research data gaps for insects. (Jaroenkietkajorn et al. 2021).

Indian states under palm oil cultivation and impact on their wildlife:

Goa

A total of 953 ha was covered for palm oil plantation, up to March 2018. And the union territory produces about 305 metric tons of palm oil in the year 2020–2021 (MoAFW). As oil palm is a water-guzzling species and has a greater impact on the soil in which it is grown in, and as this is a monoculture crop the land cannot be used for any other crop, which is not desirable. And the impacts it has on the clearing of forest and the species in it is also very damaging.

Kerala

In India, 94.1% of its palm oil imports is used in food products, especially as basic cooking oil (Sagar et al. 2019). It is well-established that India is looking to reduce its dependence on palm oil imports from Indonesia, Malaysia and others by cultivating its own plantations. This comes at a huge ecological cost. Government support in the form of subsidies is made available to farmers. Up to 85% of seedling costs and 50% on irrigation, chemical inputs and processing costs. (Srinivasan and Velho, 2018).

Kerala has two accessions of American Oil Palm *Elaeis oleifera* which were introduced from Malaysia and Costa Rica and planted at Palode, near the capital city of Thiruvananthapuram. (Pedapati et al, 2013). According to Mongabay, Kerala plans to double its palm oil cultivation in the next four years, as it just has one processing unit located in the southern area of the State. (Joseph 2021). Oil palm cultivation is linked to irreversible consequences to biodiversity and adverse effects of climate change. However, the short and long-term impacts on species and habitats have not been researched in detail for the State of Kerala.

Tamil Nadu

The Government is trying to increase the area available for the production of palm oil in Tamil Nadu and is offering many subsidiaries to farmers starting from irrigation costs to maintenance cost to reduce the oil import from other countries. Farms that are already being used for coconut cultivation and other oil seeds are encouraged to be converted into palm oil plantations but farmers are uprooting the palm trees because of problems faced in irrigation in spite of the subsidiaries provided by the government, and it is here that a number of people who had started growing the crop are shifting back to coconut. The primary reason is that — as a fast-growing and large plant — a palm requires lots of water. Both Indonesia and Malaysia have an average annual precipitation of over 2,500 mm. India's average annual precipitation comes to a little over 1,000 mm. The demand for water cannot be met by rain alone, and needs irrigation systems. This, in turn, means greater strain on water sources, especially groundwater, which leads to a falling water table.

The government expects the expansion of palm oil to happen in existing farmland, replacing other crops, or — since the plant requires three to four years to mature — intercropping.

Table 4 : District-wise Area under Oil Palm in Tamil Nadu (2015-16)		
Name of the District	**Area in Ha**	**Potential Area Identified**
Thanjavur	614.68	25000
Thiruvarur	232.35	15000
Nagapattinam	206.30	10000
Ariyalur	205.72	
Perambalur	225.51	8000
Tiruchirapalli	183.38	2500
Karur	147.92	1000
Cuddalore	1393.65	25000
Villupuram	1771.76	20000
Tirunelveli	241.29	25000
Virudhunagar	25.50	
Pudukkottai	20.30	
Sivaganagai	9.80	
Dindugal	51.0	
Erode	68.0	
Namakkal	17.59	
Salem	97.0	
Theni	130.0	25000
Tiruppur	55.0	
Coimbatore	65.0	
Vellore	800.95	11000
Thiruvannamalai	170.0	
Kanchipuram	42.20	
Thiruvallur	17.0	15000
Krishnagiri	16.50	
Dharmapuri	29.50	
Total	**6837.90**	**182500**
Source : Directorate of Agriculture, Government of Tamil Nadu, Chennai - 05		

More than half the Indian farmers are totally dependent on rain-fed agriculture, with no access to irrigation. In short, this scheme is not for them. In fact, the leading players in palm oil production in India are corporate players such as Patanjali-owned Ruchi Soya, 3F Oil Palm Agrotech, and Godrej Agrovet. Several farmers spoke about having uprooted their palms as it became unfeasible – they lost money in keeping a farm that wasn't yielding enough to harvest – and it is possible that this rejection was a larger affair than admitted. In fact, the DOPR Vision 2030 glosses over this aberration with "So far an area of 1.94 lakh ha was covered under oil palm but only 1.64 lakh ha exists at present as about 30,000 ha were uprooted due to various reasons" of the conditions prevailing in 2010. This statement of the DOPR may hide crucial ailments in the scheme to portray palm oil as the ideal crop. Much of the oil palm plantations visited in the coastal belts of Tamil Nadu had water tables that were high. However, according to government reports, all the districts visited report high salinity (electrical conductivity more than 3000 µS/cm at 25°C), fluoride and nitrates beyond acceptable limits. On the whole, only landed farmers have benefitted from the palm oil plantations, especially those that had good and sufficient access to water. In almost all cases the farmers have been able to avail of all the subsidies from both the company as well as the government and the benefit of technical advice from the extension officers. However, certain problems have affected all the farmers. These have been:

a. A bad arrangement for the procurement of the harvested fruit and delayed or irregular payments.
b. The long distance between farms and the processing plant as there is only one processing plant in Ariyalur in Tiruchirapalli district for the entire state; this delay in procurement of the fresh fruit bunches from the farm has led to the bulk of the produce from the farms being used for the production of crude oil fetching lower prices.
c. The increasing expense of wages for farm labourers.

d. The number of male-flowering palms that the farmer did not envisage and hence lost out on the profits. Research has shown that that male inflorescence is promoted by water-deficit conditions. This point was also mentioned by a farmer in Theni district who cultivated 100 acres of oil palm; he also claimed that 120 litres a day was sufficient for a palm. As in Malaysia and Indonesia, the water conditions vary little through the year, it probably does not alter the sex-ratio of the inflorescences, unlike in the drier conditions of India. The problem of an abundance of male-flowering palms that the farmers face could be related to water stress).

Karnataka

Oil palm was introduced as an ornamental crop in 1860 and planted at National Botanical Garden, Kolkata. Research on oil palm in India started during 1960 with the establishment of a research station at Thodupuzha by the Department of Agriculture, Kerala with Dura and Tenera germplasm imported from Malaysia and Nigeria. In 1981–82, Tenera accessions were introduced from Nigeria, Ivory Coast, and Zaire. Some Tenera hybrids were also imported and planted under the 'All India Coordinated Research Project' on palms at four centres, one each in Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu during 1987–88.

A total potential area of 1.93 million ha in 18 states has been identified for growing oil palm in India with diverse agroclimatic conditions. Karnataka produces 2% of the nation's total output. The area under oil palm is shrinking in Karnataka. The potential area in the State of Karnataka for oil palm development is 2,60,000 ha. Under various schemes implemented by Govt of Karnataka, about 36,000 ha were developed, which is only 14% of the potential area available. At present, only 11,983 ha (about one-third of the developed area) under oil palm is existing in the State. About 67 percent fall can be observed from the area developed under oil palm. This means, about 24,000 ha of area under oil palm has been converted to grow other crops.

Oil palm Impact in wildlife and environment in Karnataka:

- The fragmentation of natural forest habitats and the invasion of palm oil development are connected issues that have led to severe conflicts between humans and wildlife like elephants.
- Forest burning to clear land for planting oil palm and other plantations is an annual event. Draining and burning of carbon rich peatland areas also causes the release of significant volumes of sequestered carbon, which adds to the level of greenhouse gas (GHG) emissions.
- Apart from the impacts of deforestation on biodiversity, ecology and climate, oil palm plantations are also associated with ecological impacts from agricultural inputs and practices.
- Also, depletion of the water table, leaching of chemicals into groundwater sources, runoff into water bodies.

Current status oil palm cultivation in Karnataka:

Horticulture Minister B. Somashekhar visited the Central Plantation Crops Research Institute (CPCRI) in Kasaragod, Kerala, to interact with scientists. He had formed a committee headed by noted scientist P. Rethinam of the CPCRI to

study the feasibility in Karnataka. According to the committee's report, an area of 3 lakh ha of land could be brought under oil palm cultivation in the major irrigation command areas of the Thungabhadra, Upper Krishna Project, Malaprabha and Ghataprabha, Bhadra, and Cauvery. "The committee had recommended that a processing factory should be established under the public sector for every 2,000 ha of land within a radius of 40 km so that it would be possible to process the produce within 24 hours of harvesting. But despite such aspirations, the scheme did not succeed as the subsequent governments did not show much interest. This resulted in several farmers even removing oil palms from their fields", said Mr. Somashekhar.

Potential areas:

A total area of about 28 lakh hectares was determined to be suitable for oil palm agriculture in India in 2020 by the reassessment committee of the ICAR- Indian Institute of Oil Palm Research (IIOPR) 2020. 18.37 lakh ha of the overall 28 lakh ha of potential land are in the general states, and 9.62 lakh ha are in the northeastern states. The states having potential areas according to the report are Andhra Pradesh, Gujarat, Chhattisgarh, Goa, Karnataka, Odisha, Tamil Nadu, Telangana, Kerala, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal, Arunachal Pradesh, Andaman & Nicobar Islands, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura with a total of 284 districts. Currently, the three states that cultivate the most oil palm are Andhra Pradesh, Telangana, and Kerala accounting for 98% of the production. In addition, Gujarat, Mizoram, Odisha, Tamil Nadu, and large portions of Karnataka, also grow palm oil in sizable areas. Recently, oil palm plantations were also launched in Arunachal Pradesh, Assam, Manipur, and Nagaland (National Mission on Edible Oils -Oil Palm n.d.).

Mizoram

In Mizoram, palm oil has been considered a crop of immense economic promise. The state has 78 percent of the total land under oil palm cultivation in northeast India. However, the threat to biodiversity and soil fertility due to palm oil, has environmentalists, economic planners and farmers divided regarding the expansion of this crop in the biodiversity-rich state. The state government has been aggressively promoting oil palm cultivation since 2005 under its New Land Policy. Recently, the union cabinet also approved the National Mission on Edible Oils - Oil Palm with a special focus on the northeast region and the Andaman and Nicobar Islands.

Dampa Tiger Reserve, one of the last remaining tiger habitats in Mizoram, has been cultivating oil palm for the past seven years. Forest guards do not get remunerated regularly and thus have to indulge in alternate occupations like cultivating palm oil, areca nuts, rearing animals, running shops, among others to keep their families afloat. To sell palm oil fruits, they have to drive 30 kilometres to West Phaileng in Mamit district, incurring heavy transportation charges. Because of this, many farmers have given up the cultivation of palm oil and switched to areca, pineapple and banana which are easier to sell. Environmentalists agree that palm oil is harmful to the local ecology of northeast India, which is rich in biodiversity and home to a number of endangered flora and fauna. Many

experts believe that replacing wildlife habitats with palm oil risks eradicating globally important plants and wild animals. In a 2016 paper co-authored with Jaydev Mandal, a researcher formerly affiliated with Gauhati University and now an assistant professor at Madhab Choudhury College, wildlife scientist T.R. Shankar Raman of Nature Conservation Foundation (NCF) states that palm oil plantations (in Dampa Tiger Reserve) had the lowest forest bird species richness (10 species), followed by teak plantations (70).

As palm oil plantations lead to permanent loss of forest cover, the density of species is lower there. There is also an increase in human-wildlife conflict. Farmers keep complaining about how rodents and porcupines destroy palm oil crops. Previously, such conflicts were uncommon. Jhum fields were open, and fallows and regenerating forests provided habitat for ungulates such as barking deer and sambar, which served as a food source for carnivores such as tigers and clouded leopards. As a result, we can conclude that palm oil does not support the majority of wildlife.

Palm oil is a significant threat to soil fertility in addition to its impact on biodiversity. Nutrients, enzymes, and carbon are found in much lower concentrations in soil after palm oil extraction than in other types of forests.

The effect of jhum cultivation on mammalian species distribution was investigated using a transect survey for scat, camera trapping, and burrow counting. The most common visitors were barking deer (27%) and wild boar (24%). The carnivores with the greatest abundance (3-5 scat samples per jhum field) were Leopard cats and Indian Palm civets based on documented sightings. Abandoned jhum fields, 2–5 years old, were found to be a suitable habitat for large herbivore movement. The frequency of scat decreased as the jhum's age increased beyond 5 years. Clouded leopards frequented the roadside, trails, and primary forest near the active jhum forest. The encounter rate for active and old rodent burrows was 3.56 km^2 and 2.68 km^2 in 1–2 year old, recently abandoned jhum fields, respectively. Camera trapping yielded 36 images of various animal species. Mammalian distribution is aided by increased spatial heterogeneity.

Andhra Pradesh

The biggest importer and the second biggest consumer - this is where India stands with respect to palm oil. And wonder which state in India produces the oil the most? Andhra Pradesh (Horticulture Department 2018). It contributes to 83.5% of the total palm oil production of the country (Pandey & Aggarwal 2021). With plantations spread over an area of 1.62 lakh ha (which is the highest area in the country), the state sees an average productivity of 19.81 tons per ha from the bearing plantations. The plantation helps over 1 lakh farmers earn bread (Horticulture Department 2018).

Initially cultivated on lands which were once paddy fields, this water gulping plant flourished in Andhra Pradesh (even in water scarce areas of the state) due to the rampant supply of groundwater (Ramnath 2018). As of now, a total of 229 mandals in nine districts (Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari, Krishna, Nellore, Ananthapur,

and Chittoor) have been identified for the palm oil cultivation (Horticulture Department, 2018). However, the state has been facing water scarcity, and as a result, farmers have now slowly begun to shift from it (Pandey & Aggarwal 2021).

Effects on nature in Andhra Pradesh:

Grey literature on palm oil plantation/ cultivation's effect on habitat is close to none. Thus, an inference cannot be made. In a recent study by Sreenivasan et al. (2022), there are explanations of how palm plantations in north-east India is not a good idea. However, in the case of Andhra Pradesh and Telangana, there is no such mention of completely avoiding plantations from there. The only suggestion made was to regulate the cultivation so as to save the habitat and the species, e.g., Indian Wolf *Canis lupus pallipes* and Lesser Florican *Sypheotides indica*, which could face threats otherwise.

Telangana

The state of Telangana stands 6th in the palm oil arena. It's the second largest producer of the Fresh Fruit Bunches (FFBs) (the ripe palm fruits from which the oil is extracted), only after Andhra Pradesh (Horticulture Department Telangana, 2018). Here, the oil plantation is spread across 36,421 ha of land and 23,000 farmers are employed in the cultivation. The state also stands 1st in Oil Extraction Rate (OER) in the country (Pandey & Aggarwal 2021). By providing employment to over thousands, palm oil plantation assures income which is fixed by the Government adhering to the Oil Palm Act 1993 and AP Oil Palm (Regulation of Production and Processing) Rules 2008 (Horticulture Department 2018; Pandey & Aggarwal 2021). In addition to it, subsidies on irrigation equipment, fertilisers, and intercropping are provided (Pandey & Aggarwal 2021).

However, these subsidies cease to exist after four years when the palm trees start bearing fruits. Thus, to sustain the plantations, farmers have to use groundwater. A mature oil palm tree requires 200–250 litres of water. However, as seen in Andhra Pradesh, water scarcity is an issue in Telangana as well. And thus, farmers have started shifting to other alternatives (Pandey & Aggarwal 2021). In an attempt to achieve more than the target given by the union government, the Telangana government has now planned to cultivate palm oil in 80,937 ha of land in the next four years. That is, to increase 22 times the existing cultivated area (Pandey & Aggarwal 2021).

Effects on nature in Telangana:

Though there are mentions of plantations to be one of the causes of loss of forest cover in Telangana, no literature has yet mentioned palm oil plantation specifically. Reddy et al. (2015) in their study highlight the high levels of forest cover loss that has taken place between 1975–2013 in 2 districts of Telangana - Khammam and Nalgonda. Both of these districts are known to have the most palm oil plantations (Pandey & Aggarwal 2021). From this, it can be inferred that the plantation that is leading to mass forest loss as mentioned in the paper could most probably be of palm oil. Simply put, palm oil cultivation causes forest clearance. No literature on wildlife affected due to this could be gathered for Telangana.

Latest Developments:

1. Agreements with the governments of Assam, Manipur, and Tripura for the development and promotion of oil palm farming by Godrej Agrovet (Oil Palm Cultivation, n.d.).
2. In order to increase their cooperation in promoting the use of palm oil, the Indian Vegetable Oil Producers' Association (IVPA) and the Malaysian Palm Oil Council (MPOC) have signed a memorandum of understanding (MoU). The MoU is projected to boost the production and consumption of palm oil from Malaysia and collaborate in areas of shared interest.

Conclusion

Oil palm is considered to be an efficient crop with high global returns. To meet the rising global demand for palm oil throughout the world, palm oil plantations are being expanded in the major palm producing countries such as Indonesia, Malaysia, and Thailand. Palm oil is used in almost all packaged foods and other commodities due to its cheap price and ability to maintain freshness of shelved products. In order to reduce imports and increase self-sustainability, India started growing palm oil in different States like Andhra Pradesh, Goa, Karnataka, Assam, Kerala, Gujarat, Tamil Nadu, Maharashtra, Mizoram, Tripura, West Bengal, Telangana, and some areas of Andaman practice palm oil cultivation. However, farmers in these areas have shown desires to shift their cultivation to other crops due to certain difficulties in cultivation and the high water requirement of the plant, which is affecting the ground water levels in these States.

The issue of higher concern is that of cutting down forest lands that will lead to habitat loss of various species and thus, making them vulnerable to anthropogenic activities, poaching, hunting, exports, etc. If we look at the examples from Indonesia, Malaysia and Thailand, we can infer the amount of damage that palm oil cultivation causes to wildlife and vegetation. Borneo and Sumatra, which are collectively one of the largest producers of palm oil in the world, have compromised their endemic species like Bornean and Sumatran orangutans, pygmy elephants, elephants, tigers, rhinos and many other species to palm oil cultivation. However, stopping palm oil cultivation altogether is not an economically viable option, looking at the amount of market products that depend on palm oil. Hence, finding an intermediate way or a replacement is important for sustainable palm oil growth along with protection of wildlife and forests in the country.

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