Environmental and Social impacts of Palm oil industry in Sri Lanka

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Abstract- Currently, the palm oil industry is at the highest position in the international vegetable oil market. This paper reviews the environmental and social problems which are related to the development of the palm oil industry in Sri Lanka.Moreover, this article contains the details about palm oil consumption patterns and the sustainable ways of palm cultivation in the lands. There are several palm oil industries in Sri Lanka. So this article shows the suitability of the palm oil industry to Sri Lanka. The details about how palm oil affects the human body and what are the substitutes for the palm oil and chemical compositions, details about the plant also included in this article. In Sri Lanka, the government has taken some legal actions to reduce the harmful impacts of palm cultivation and improve sustainability in the palm oil industry. When considering the social effect, there is enormous job creation by the palm oil industry. Nowadays, environmentalists and some N.G.O.s are congregating against the palm oil industry. So this article contains all the facts mentioned above from that report.

Key Words: Environmental Impacts, Palm Oil, Social Impacts, Sri Lanka.

1. Introduction

The oil palm originated from West Africa, where evidence of its use as a staple food crop dates as far back as thousands of years. Palm trees grow well in the tropical climate. Therefore it spread from West Africa to South and East Asia as a result of the industrial revolution and economic expansion. Palm oil became a versatile and essential vegetable oil which became an important raw material that is used in cosmetics, baked foods, detergents, shampoo, and even biofuel. Most importantly, It is nutritionally, rich, edible vegetable oil. Knowing the economic value of oil palm, the westerners invested in its cultivation in West Africa, followed by Southeast Asia. Palm oil cultivation was started in Sri Lanka in 1967 with the introduction of the palm plant to Sri Lanka by Malaysia. The first cultivation was started by a European planter named Jerry Wales at Nakiyadeniya estate with sixty-eight palm trees. Firstly the palm plantation was started at 100 hectares. Then It was rapidly spread in the southern zone of Sri Lanka as it was identified as a highly economical and profitable crop. Therefore, they started to clear forests and planted palm seeds in those lands. Palm Oil fruits and fruit bunch are shown in the **Fig. 1**[1].


Fig. 1. palm oil fruits and fruit bunches

At present, Sri Lanka has several oil palm fields, but Sri Lanka has only two oil separating stations. They are situated in Nakiyadeniya and Pelawatta. All palm fruits are transported to those stations, and the oil is separated from fruits [2,3] After the planting of palm seeds, it takes about four years to give the first harvest. And it can give harvest continually for thirty years. A thirty-year-old palm tree has a height of about forty feet. A healthy oil palm tree gives about twelve to fourteen bunches per year. A bunch has many palm fruits. Usually, palm bunches grow up to a weight of 10 to 25 kilograms. When the fruit bunches are ripe, they turn into a maroon to orange color, and that is when they can be used for oil separation.

2. Production Process

The palm oil production process consists of several steps. It involves gathering of fruit bunches, sterilization, and separation of fruits from bunches. Then the palm fruits are mashed to squeeze out the palm oil. This step produces a crude oil which is further purified and dried. This treated oil is then exported or stored.

Fresh fruits arrive as fruit bunches. After arrival, these bunches are weighed. The quality of the bunches mainly depends on field factors such as genetics, age of the tree, environmental factors, harvesting method, and transportation. Then the removal of fruits from fruit bunches is done, which is known as “threshing. Steam under pressure is applied to fruit bunches to help remove the fruits, which is also a sterilization process. The threshing process can be manual or mechanical.

During manual threshing, the fruit embedded spikelet is pressed using a skid-steer loader to remove the fruit from the spikelet. In the mechanical method, it is done using a spinning drum or fixed drum with rotating beater bars. The oil extraction process primarily consists of four steps, such as sterilization, stripping, digestion, and finally, the oil separation.A flow chart of the oil extraction process is given in the **Fig. 02**.

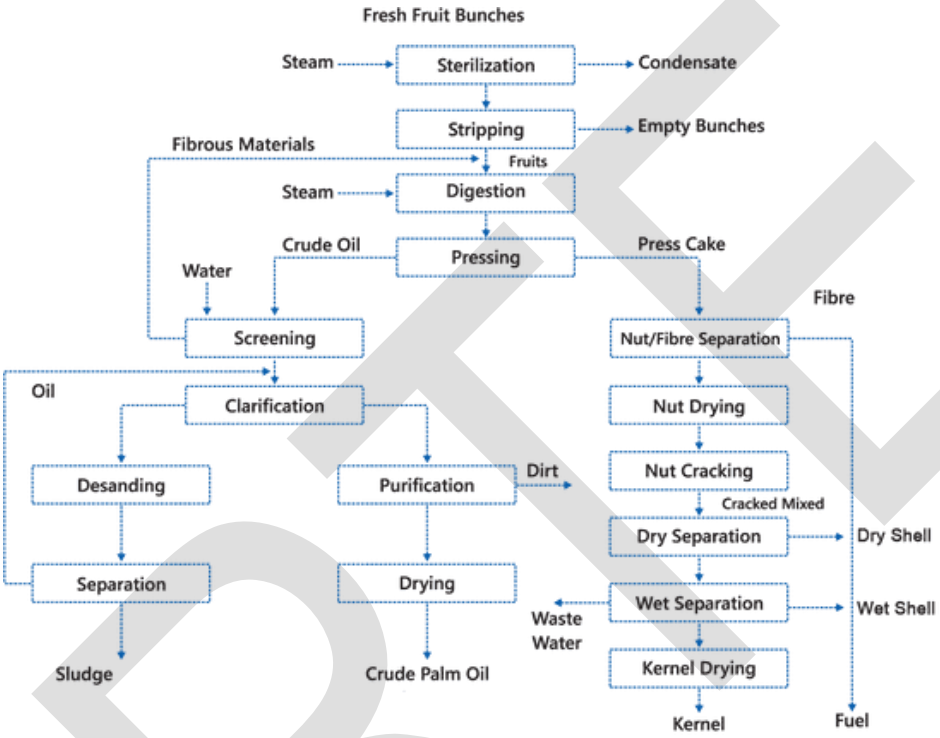

Fig. 2. Oil separation process using palm fruits.

Sterilization of bunches

For this purpose, a wet heat sterilization method is used. Fruit bunches are subjected to high temperature and pressure. The heating process is done at 145 degrees Celsius for 90 to 120 minutes. In this step, the hydrolytic and oxidative processes and oil splitting enzymes are inactivated. It also destroys fungi, bacteria, and insects. It is kind of a cleaning process as well. Bunches get cooked, making it easy to separate the fruits from them. Furthermore, when the humidity of fruit bunches gets increased, and palm oil can be extracted easily. This is because the heat causes solidification of proteins in which the oil cells are dispersed microscopically and partially disrupts the oil cells. The cooking of fruit bunches also softens the pulp so that the fiber can be easily separated during the digestion process.

Stripping

In the stripping step, the fruits are separated from sterilized fruit bunches. In this process, sterilized fruits are filled to a crannied cylinder, which rotates. Because of the rotation, the fruits are separated from bunches, and they fall into collector bins, and empty bunches remain inside the cylinder.

Digestion

In this step, the separated and sterilized fruits are reheated with steam and mixed using mechanical mixing arms. In this step, the fruits get crushed, decreasing the viscosity of the oil, making it easy for separation. It also destroys the outer covering of the fruits and completes the oil cell break down, which was already partially disrupted during the sterilization process. After digestion, the fruits are ready for the oil separation process.

Oil separation

There are two pressing methods that are used to extract oil from the digested fruits. One method is known as the "dry technique," which is an automated method. Here mechanical pressing is used to extract the oil. The other method is known as the "wet technique," which is a method that uses hot water to separate the oil. There are several types of pressing methods such as batch press, continuous press and etc. In the batch presses, a metal plunger is used to press the material placed in a metal cage.

The separated oil then goes through a vibrating pipe to separate large particles that were left in the pressing step. This crude oil is then refined after the removal of impurities such as phospholipids, free fatty acid, carotenoids, moisture, and oxidative materials. Removing the impurities will improve the physical appearance and increase the shelf life and stability.After oil separation, kernel recovery is made by mainly large scale millsRecovered fiber, and nutshells are combusted in boilers to generate steam, which can be used to operate turbines and generate electricity for the oil plant itself.

Waste generation

Apart from crude oil and kernels, which are the main products, a large amount of residues like fiber, nutshell, and empty fruit bunches remains as waste products. Including the wastewater, these should be discharged according to the industry-specific effluent discharge standards. But in Sri Lanka, it is done under general standards specified by the Central Environmental Authority.

3. Social and Environmental Problems

The Palm Oil conflict began in Indonesia when large areas of rainforests were cut down to start palm oil cultivation. Although the income was profitable, there had been many social and environmental issues related to the industry, such as loss of livelihood and global warming. This situation is similar in Sri Lanka, although the necessary attention has not been paid.Therefore in this part, we hope to describe the environmental and social impacts and how to prevent them by continuing oil palm cultivation sustainability in Sri Lanka. According to the data gathered from villages near palm fields, some social and environmental problems which occur around the oil palm fields are discussed below. This information is also based on previously written research articles on "Impacts of Palm oil industry In Sri Lanka [4].

Social impacts

- **Violation of land- use rights and loss of livelihoods due to deforestation**

  The establishment of large scale palm plantations had resulted in taking over the hereditary lands of native people along with their livelihoods, culture, and traditions. Due to deforestation, other cultivations carried out by the native people in those lands were lost, making them unemployed and economically unstable.This also reduced access to land for future generations.

- **fewer job opportunities and reduction in income**

  Before the introduction of the palm oil industry, the lands of these areas were cultivated with rubber. As the production of latex decreased during rainy seasons, the owners have decided to remove rubber trees and plant palm trees instead. Many people in these areas receive a daily income by working in rubber fields. They worked at least 3 hours in the morning and 2 hours in the afternoon to collect the latex. Then the rubber -scrap was sold to a price of Rs. 350/= per kilogram. After introducing oil palm, those labourers who worked in rubber fields had to find other jobs as the palm oil industry had less potential to offer enough job opportunities like in the rubber industry. Also, palm trees give the harvest after about four years, and people have to wait until then.

  In addition, people who lived around these areas used to collect firewood from the rubber plantations for their daily consumption, and the excess was sold as a means of extra income. But now, people have to buy firewood for their consumption. Also, before planting of palm trees, people cultivated some secondary crops like Gotukola, pineapple in rubber fields and received some extra income by selling them. Now all these means of income have ceased. Therefore the economy of people in areas of the

palm oil industry has declined [5].

- **Less labour safety**

During our visit, we focused on the safety of labourers as well. These fields were nearly seven years old, and the trees were not very tall.The workers did not wear safety helmets and boots when they were working. Because of this, they sometimes get injured being hit by the branches and leaves, which are known to be toxic.The main reason for this is the unawareness of the workers.The palm industry owners should be responsible for this lack of awareness by the workersbecause the workers' safety is one of the owners' responsibility.

- **Involvement of Child labour**

Child labour is another problem in oil palm plantations. Children who are employed in palm plantations receive a little amount of money.They are sometimes forced to work under unfavorable conditions, or they are asked to do hard work or overwork with no safety precautions. Exposure to toxic chemicals is another danger faced by these children. Poor education and the lack of schools in rural areas are the main reasons for such circumstances [6].

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- **Decreased groundwater level leading to future water scarcity.**

After the introduction of palm cultivation, there is a risk of decreasing groundwater levels in these areas.we will be discussing that fact in the environmental effects section, and now only the social problems related to this are discussed. People obtain their daily water needs from water springs or by digging wells in areas where palm trees are highly cultivated like Galle and Central Province.If the groundwater levels decrease. E people have to travel to faraway places to bring water for their daily consumption utilizing their time and money.Therefore, this is one of the identified social problems related to the oil palm industry and fields.

The Environmental Impacts of the palm oil industry

- **Deforestation**

With the introduction of the palm oil industry, a lot of forest reserves were destroyed to make the land for palm plantations.Because of deforestation, the plants cannot control the CO_2 levels in the atmosphere in those areas. .Increased CO_2 levels contribute to an increase the global temperature

because it is the main greenhouse gas on the planet.The large forests and the secondary undergrowth forests retain a large quantity of CO_2,and it contributes to maintaining the global temperature at the average level.But because of the oil palm cultivation, the primary forests are destroyed, and there is no chance for an undergrowth secondary forest in the field.To prevent that problem, it is needed to plant more oil palm trees, because, by that way, the amount of CO_2 consumption of the forest can be met by oil palm CO_2 consumption. To cultivate oil palm in a sustainable way, the land must be covered with more palm trees because it can meet the CO_2 capacity, which was absorbed by the forests that covered the land previously. Can oil palm absorb CO_2 and emit more O_2 than natural forests?.A comparison of the Carbon dioxide absorption and oxygen production between oil palm and tropical forests isgiven in**Table1.**

If the deforestation involves firing, it can emit a large amount of carbon dioxide to the atmosphere as well.Also, burning carbon-rich swamps can emit a large number of greenhouse gases.In addition to this, palm oil mill activities such as the combustion of fossil fuel in machinery and vehicles further increase the emission of carbon dioxide to the environment.Also,affluent and fertilizer can be other sources of greenhouse gases such as Nitrous oxide and Methane [7].

Table 1. Carbon dioxide absorption and oxygen production of oil palm vs. tropical forests.

Indicators	Tropical forest	Oil palm plantation
Gross assimilation(tons CO_2/ha.year)	163.5	161.0
Total respiration(tons CO_2/ha.year)	121.1	96.5
Net assimilation (tons CO_2/ha.year)	42.4	64.5
Oxygen production(tons O_2/ha.year)	7.09	18.70

❖**The threat to biodiversity and loss of habitats**

Deforestation has resulted in the loss of biodiversity and the habitats of many kinds of animals. It also influences the natural food chains and symbiotic relationships and threatens the ecological balance. For example, the undergrowth of forests hosts many animals. When we compare an oil palm plantation and a normal forest, the undergrowth in palm cultivation is less than that in a normal forest. In an oil palm land, there is very little or no chance of an undergrowth. Animals that lived in undergrowths, including frogs, rodents, snakes, and insects had lost their habitats due to this reason.

As a result, animals like monkeys and apes have invaded the villages around forests and damaged the

crops cultivated by farmers. This, in turn, poses threats to the lives of animals because they often get hunted by the people. The release of effluent and chemicals to the freshwater bodies adversely affects the aquatic flora and fauna, leading to loss of aquatic biodiversity.if not paid enough attention, this will lead to future endangerment or extinction of important animal species endemic to Sri Lanka.

- **Decrease the groundwater level and pollute the surface water because of the sludge.**

The groundwater levels near the oil palm fields are decreasing continuously. The natural water springs and dug wells will dry up with time because of the high water consumption of oil palm plants.It absorbs all groundwater. That is the reason for the drying up of wells and springs near the plantations.

Normally, one oil palm tree absorbs 1.83mm to 4.13mm water daily. In an oil palm field, there are thousands of trees, and all of the trees absorb high amounts of water. Before the oil palm plantations, the lands were filled with rubber trees. Rubber can contribute to protecting groundwater storage. But the oil palm plantations highly affect the groundwater levels and decrease it. A comparison of the characteristics of the water cycle and connected variables between palm plantations, rubber plantations, and a forest is given in the **Table2**.

Table 2. Characteristics of the water cycle and connected variables of oil palm plantations,rubber plantations, and forests.

variable	method	oil palm	rubber	forest
Evapotranspiration	Eddy covariance	4.7 mm d-1	N.D	N.D.
Transpiration†	Sap flux	1.8 mm d-1	lower	similar
Rainfall interception	Rain gauges	28%	lower	N.D
Soil carbon content	C.N. analyzer	2.1%	similar	higher
Air temperature	Thermometers	25°C	similar	lower

After oil separation, the remaining sludge is usually dumped into the plantations.The sludge takes a long time for biodegradation, and it has some remaining oil as well.During rain, the oil in the sludge flows with the water and deposit on surface water sources, making them unsuitable for human consumption.

- **Environmental pollution**

Environmental pollution can be described in several ways as Air pollution, Water pollution, Soil pollution, and noise pollution. Air pollution due to the burning of forests and fossil fuels in the palm oil

industry is already discussed under the effects of the emission of greenhouse gases.In addition,this emission of smoke due to firing, has created many health problems in people around palm plantations, including respiratory difficulties and irritation of eyes.A palm oil factory generates and discharges nearly 2.5 MT of effluent per One MT of palm oil production.This effluent is directly released to freshwater sources causing serious water pollution. The use of pesticides and chemical fertilizer in large amounts leads to the seepage of these chemicals into groundwater sources and spoilage of surface water sources.Some of these chemicals can be toxic to aquatic flora and fauna.In addition to these runoffs, and leaching of nutrients from fertilizer reduces the water quality leading to eutrophication and acidification,.Sedimentation can make the river's shallow making the lowlands more prone to floods.

Noise pollution is another problem associated with palm oil industries in Sri Lanka.This is due to the operation of heavy machinery inside the mills, which emits a big noise and sometimes the noise due to transportation vehicles.

- **High soil erosion**

In the oil palm fields, high soil erosion occurs.There is no undergrowth in the oil palm fields. Therefore the water flows directly over the topsoil, causing erosion. Some of the soil bacteria living in the topsoil contribute to making productive soil. But because of the erosion, these bacteria are removed. Also, palm trees are mostly cultivated in lands with a slope. As a result, soil erosion is further increased.

In the rainy season, due to high runoff, the nutritions are lost from the soil, and the soil becomes eroded. .This is a big environmental problem too.In order to prevent soil erosion,stone ridges can be added to necessary places when regular canals for flowing water are made in the fields. Using these methods, soil erosion in the oil-palm plantation can be reduced.

- **Susceptibility to droughts and wildfires**

Deforestation will result in an increase in the surface temperature.This is caused due to reduction of water evaporation due to reduction of trees.It can lead to rainless prolonged drought conditions in these regions, making them more susceptible to wildfires.Cutting trees in areas known as “catchment areas,” which are highly sensitive ecosystems can affect the rainfall and even lead to droughts.

Whatis sustainable palm oil?

In Sri Lanka, vegetable oil production is 164 million per year. Out of that, palm oil production is 59 million.

Palm is the major crop that is used to make vegetable oil. Though it is a very profitableindustry at present, the question remains whether it is a sustainable industry.The reason is that it has led to many social and environmental disasters, as discussed in this paper.Therefore the palm oil cultivators and government should focus on how to cultivate oil palm in a sustainable way.

What is the R.S.P.O organization? (The Roundtable on Sustainable Palm Oil)

The R.S.P.O. is an organization that is globally recognized for the palm oil industry conference on R.S.P.O. was established in 2004 with the aims of monitoring and evaluating economical social and environmental impacts of the palm oil industry while advancing and ensuring the production and supply.It also develops, assures, implements, and periodically reviews global standards of sustainable palm industry.A list of principles that the planters should fulfill to get the R.S.P.O certification is shown in **fig.3**.

About 40 % of the world's oil producers are unit members of the R.S.P.O., likewise as several product makers, retailers, environmental and social non-governmental organizations (N.G.O.s).

To minimize the social and environmental impacts, R.S.P.O has introduced eight criteria which should be followed by the oil palm companies.If they are properly applied in the field by the companies, they can minimize the above impacts in palm cultivated regions while increasing their own profit.

Fig. 3. principles for growers to be R.S.P.O. certified

4. Conclusion and Suggestions

Palm oil is a vastly helpful product for humans. Also, it is a major economic cropin our country and the world. However, there are many emerging social and environmental problems caused due to this industry, such as violation of land rights,affecting the economy of native people, environmental pollution,deforestation, and related issues like the greenhouse effect, droughts, and endangerment of endemic animals species.Ignoring this situation can lead to irreversible natural disasters.Therefore the planters and smallholders of the palm industry should focus on the concept of the green palm oil industry and get the R.S.P.O. Certificate to their fields. Justified allocation of lands,maintaining ecological integrity, the use of disease-resistant plants,proper waste management,treatment and recycling, good management practices, and labor safety can minimize most of these impacts.The industries related to oil palm can also reduce their daily fuel or energy consumption by finding alternative energy sources. .For example, they can use crushed bunches as a source of fire for water boilers. Technologies should develop to use the waste materials of the palm industry as biofuels and building materials.These options will only minimize adverse effects. But sometimes these methods may not be successful.Therefore the best option is to find a sustainable alternative to palm oil in order to stop the impacts.

References

[01] strong growth predicted for Lankan oil palm industry (F.C. research quoted by mirror business) in January 5,2017

[02] H.M. Weerasekara, Cleaner production in palm oil industry Sri Lanka, Master Thesis, University of Moratuwa, 2006.

[03] www.goldenagri.com/home/newsroom/blogs/how oil palm grown

[04] Udara. S. P. R. Arachchige, Chiran D. M. O. Ranaraja, Nirmala W.K.J, Preethika D.D.P, Rangajith D.G.P.H, Sajath S.H.M, Impacts Of Palm Oil Industry In Sri Lanka, INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 8, ISSUE 08, 1137-1145, 2019.

[05] Jennifer M et. al, Water scarcity and oil palm expansion: social views and environmental processes, Ecology and Society 21 (2), Art. 5, 2016.

[06]https://greenpalm.org/about-palm-oil/sustainable-palm-oil/rspo principles and criteria for sustainable palm oil(principle and criteria for the production of sustainable palm oil -2013/accepted concept by executive board for the extraordinary general assembly on april 25th /2013

[07] Lisma. S, Hermantoro. H, Sentot. P, Valensi. K, Satyanto. K.S, Agung. K, Water Footprint and Crop Water Usage of Oil Palm (Elaeis guineensis) in Central Kalimantan: Environmental Sustainability Indicators for Different Crop Age and Soil Conditions, Water, Vol. 11, Issue. 35, 2019.