

Impacts Of Palm Oil Industry In Sri Lanka

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Abstract—The evolution of renewable energy over the past and recent decade is the huge turning point of humans. This tendency has been occurring due to increasing of fossil fuel pricing, rising demand for energy and scarcity of non-renewable sources. Biomass is the primary eco-friendly renewable resource in all over the world. One of the significant biomass resources is palm oil. Palm oil industry currently occupies the topmost position in the international vegetable oil market. This paper reviews the development of the palm oil industry within the analyses associated with environmental and social impacts and also evaluating existing palm oil sustainability initiatives in Sri Lanka. We selected one plantation and agriculture study site in Sri Lanka to show evidence of the impacts. This research article findings and indicating that the development of palm oil cultivation has been caused significant environmental impact such as deforestation, resulting in significant impacts for water pollution, noise pollution, soil erosion, biodiversity loss, GHG emissions and also air pollution. In terms of social impact, there having some part of adverse effect to many groups like employees, suppliers, shareholders, investors, landholders, and ordinary people as well. However, we found that not only impacts but also has many benefits to those parties as well. In this article, we also try to introduce and suggest to prevent environmental pollution and reduce it.

Index Terms— Environment, Palm oil history, global market, Environmental Impact, Waste disposal

1 INTRODUCTION

The oil palm cultivation first began in Africa and the economic revolution spread in South Asia, especially in Malaysia, Indonesia with Thailand and Papua New Guinea. The oil palm tree (*Elaeis uineensis*) originated from West Africa, which grows in the tropical climate and it is a versatile and essential vegetable oil which is used as raw material for both food and non-food industry. Figure 1 is representing Palm Oil tree, and Figure 2 is a bunch of palm fruit is given respectively.



Figure 1: Oil Palm Tree



Figure 2: Bunch of palm fruit

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It can handle frying without spoiling and also blends with other oils as well. It is a combination of different type of facts and provides forming agent in every shampoo, liquid soap, or detergent [1]. In the beginning, it grows only in the wild, and later it was developed into agriculture crop. While oil palm was growing in West Africa, the use of palm oil in international expand quickly as an effect of the industrial revolution and the expansion. From candle making to industrial lubricants, palm oil was a significant effect behind the expansion of industrial production while nutrient-rich red palm oil became an essential element on long seafaring voyages. Moreover, it was a result of the increased of that Europeans began investing in palm oil production, first in West Africa and then expanding to Southeast Asia. With the process of expansion, Worldwide palm oil production had

increased from 15 million tons in 1995 to 66 million tons in 2017. Indonesia is the world leader in the production of crude palm oil, and it also has been successful in supplying the domestic and world market with palm products and palm derivatives. Today the total land area planted to oil palm in Indonesia has reached 9.7 million hectares. Also, the global palm oil market size was estimated at USD57.56 billion in 2014[2]. M. Jerry wales a European planter commenced the cultivation of palm oil in Sri Lanka in 1968 at Nakiyadeniya estate by planting 68 oil palm plants. Since 1968 oil palm cultivation has rapidly increased through the low country wet zone Sri Lanka as it was seen as an economical and profitable crop. After introducing the palm tree to Sri Lanka, it has spread over 1000 areas of the country. About 164835 Mt of palm oil is produced in Sri Lanka every year [3]. According to the present research, It can be identified that there are two palm oil processing industries in Sri Lanka, Watawala Plantation and AEN plantation. Palm oil Processing Factory managed by Watawala Plantation PLC at Nakiyadeniya is the largest oil palm mill in Sri Lanka which has advanced technology. The mill commissioned in 1980 a small-scale industry and in 1992 expanded its capacity to process 15, 000 fresh fruits bunches per hour. Nakiyadeniya oil palm mill is produced different types of palm oil such as Crude palm oil, Palm kernel oil, Palm kernel cake, R.B.D palm olein, and stearine and other [4]. The second palm oil factory is AEN Palm oil Processing (Pvt.) Ltd at Baduraliya factory which is a joint venture of Agalawatta Plantation PLC, Elpitiya Plantation PLC, and Namunukula Plantation PLC factories. AEN factory is processing capacity of 10,000 fresh fruits bunches per hour. This is a boar of investment approved project, and the produce is exported to India. The comparison of palm oil production industries is given in Table 1.

Table 01: Production details of Palm oil industries of Sri Lanka [5]

Parameters	Nakiyadeniya Palm oil Processing Factory	AEN Palm Oil Processing (Pvt.) Ltd
Production Capacity/hr	15,000 fresh fruits bunches(15MT)	10,000 fresh fruits bunches(10 MT)
Working hrs	13 hrs/day	08hrs/day
FFB Process/day	About 180 MT	About 200 MT
Daily Production Crude Palm Oil Palm Kernel Oil	About 42 MT About 55 MT	About 4.2 MT About 4.5 MT
Water Requirement Processing	110 m3/day	03 m3/day
Washing Domestic	50 m3/day	02 m3/day
Water Discharge	03 m3/day	0.5 m3/day
	75 – 80 m3/day	100 m3/day
Effluent Treatment	Treatment Available	Plant Treatment Plant Available
Final Discharge	Oil Palm Cultivation	Dispose via Madampitiya Pump Station.
Solid Waste EFB	About 18-20 MT/day	About 10 MT/day
Fibre	About 40 MT/day	About 8 MT/day
Nut Shell	About 18 MT/day	About 4 MT/day
Press Cake	About 34 MT/day	About 3 MT/day
In-plant Energy Generation	2500 kwh	300 kwh
Expected Expansions -.		Expect to expand the capacity up to 20 MT/hr within 2 yrs

2 PROCESS DESCRIPTION

The oil production process, involves the gathering of fresh fruit bunches from the farms, sterilizing and separating of the bunches to free the fruit. Mashing the palm fruit and squeezing out the raw palm oil. The crude oil is more treated to purify and dry it for storage and export. In large-scale industries, they are featuring all stages required to produce palm oil to international standards. The large installations have mechanical handling systems such as bucket and screw conveyors, pumps and pipelines that operate continuously. Boilers, fuelled by fiber and shell, produce steam, used to produce electricity by turbine generators and low-pressure steam from the turbine is used for heating operations throughout the plant. Mostly the processing operations are automatically controlled and routine sampling and analysis by process control laboratories to keep efficient operation. Production of crude palm oil to refined oil involves removal of

the products of hydrolysis and oxidation, color and flavor. After that, the oil may be separated into liquid and solid phases by controlled cooling, crystallization, and filtering. The flow diagram of palm oil production is given in Figure 3.

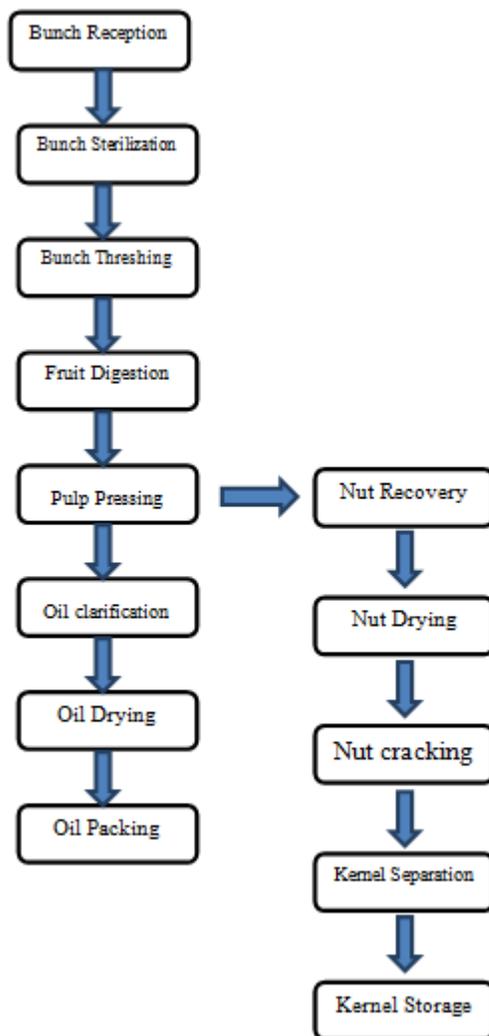


Figure 3: Process Flow Diagram

Bunch gathering

Fresh fruit arrives from the plantations as bunches. The fresh fruit is weighing on a weighbridge to check large quantities in trucks. Large installations use the quality standard gained is initially dependent on the quality of bunches arriving at the factory. The plant cannot improve upon this quality but can prevent or minimize further deterioration. The field factors that affect the production and final quality of palm oil are genetic, age of the tree, environmental, harvesting method, treatment, and transportation. Many of these factors are beyond the handle of a small-scale processor.

Threshing (removing the fruit from bunches)

The palm fruit bunch consists of fruit embedded in spikelet's growing on a central stem. Manual threshing is achieved by pressing the fruit-laden spikelet from the bunch stem with a skid-steer loader and then separating the fruit from the spikelet. In a mechanized system, a spinning drum or fixed

drum equipped with rotating beater bars separate the fruit, leaving the spikelet on the stem. Whole bunches, which include spikelet, absorb much moisture in the cooking process. High-pressure steam is more efficient in heating bunches without losing much water. Therefore, high-pressure sterilization systems thresh bunches after heating to loosen the fruits. In larger factories, the bunch waste is burned and the ash, a rich origin of potassium, is returned to the farm as fertilizer.

Sterilization of bunches

Sterilization is the process of high-temperature wet-heat treatment of loose fruit. Sterilization uses pressurized steam. Heat treatment stops oil-splitting enzymes and arrests hydrolysis and oxidation. Bunches are cooked whole; the wet heat dilutes the fruit stem and makes it easy to separate the fruit from bunches on shaking or tumbling in the threshing machine. The heat helps to solidify proteins in which the oil-bearing cells are microscopically dispersed. The protein solidification allows the oil-bearing cells to come together and flow more smoothly on the use of pressure. Fruit cooking decreases the pulp structure, softening it, and making it easier to divide the fibrous material and the contents through the digestion process. The high heat is enough to disrupt the oil-containing cells in the mesocarp partially and allows the oil to be released more readily. The moisture added by the steam works chemically to break down glues and resins. The gums and resins let the oil to foam during frying. Carbohydrates present in the fruit are hydrolyzed and separated in this method. When the high-pressure steam is used for sterilization, the heat causes the moisture in the fruits to expand. When the pressure has decreased the reduction of the nut leads to the detachment of the kernel from the nut wall, thus loosening the kernels within their shells. During sterilization, it is essential to ensure removal of air from the sterilizer. Air not only acts as a wall to heat transfer, but oil oxidation rises at high temperatures. Hence, oxidation risks are high during sterilization. Over-sterilization can also drive to poor bleach-ability of the final oil.

Digestion of the palm fruit

Digestion is the process of delivering the palm oil in the fruit through the separation or breaking down of the oil-bearing cells. The digester generally used consists of a steam-heated tubular vessel fitted with a central rotating shaft supporting several mixing arms. Through the action of the rotating mixer arms, the fruit is crushed. Crushing, or digesting the fruit at high temperature, helps to decrease the viscosity of the oil, destroys the fruits' outer covering and completes the disruption of the oil cells already begun in the sterilization phase.

Pressing (Extracting the palm oil)

There are two ways of extracting oil from the digested material. One system uses automatic presses and is called the "dry" technique. The other called the "wet" process uses hot water to leach out the oil. In the dry process, the objective of the extraction step is to squeeze the oil out of a mixture of oil, moisture, fiber, and nuts by using mechanical pressure on the

digested mixture. There are a large number of various types of presses, but the system of operation is similar for each. The presses may be designed for batch or continuous processes.

Batch presses

In batch operations, the material is placed in a heavy metal cage, and a metal plunger is used to press the material. The plunger can be driven manually or by a motor. The motor-driven method is faster but more expensive. Different designs use either a screw thread or a hydraulic system to drive the plunger. Higher pressures may be achieved using the hydraulic system, but care should be taken to assure that toxic hydraulic fluid does not reach the oil or raw material. Hydraulic fluid can absorb the moisture of the air and drop its effectiveness, and the plungers wear out and need regular replacement. Spindle press screw threads are made from steel and supported by steel nuts so that the nuts wear out faster than the screw. The pressure should be risen gradually to allow time for the oil to leave. If the depth of material is too high, the oil will be trapped in the center. To stop this, heavy plates' can be included in the raw material. The production speed of batch presses depends on the volume of the cage and the time needed to fill, press, and clear each batch.

Clarification and drying of oil

The primary purpose of clarification is to divide the oil from its entrained contaminants. The liquid coming out of the press is a mix of palm oil, water, cell debris, pulpy material, and non-oily solids. Because of these non-oily solids, the mix is quite thick. Hot water is therefore mixed to the press output mixture to reduce it. The dilution gives a barrier producing the heavy solids to settle to the bottom of the container while the smaller oil droplets flow through the watery mix to the top when the heat is applied to split the oil suspended in water with the aid of gums and resins. The diluted mix is transferred through a screen to remove fiber. The screened mixture is boiled and then let to settle by gravity in the huge tank so that the oil, being lighter than water, will separate and rise to the top. The clear oil is decanted into a tank. This clarified oil still carries traces of water and dirt. To stop increasing FFA through autocatalytic hydrolysis of the oil, the moisture content of the oil must be decreased to 0.15 to 0.25 %. Heating the oil in a cooking vessel and carefully skimming off the dried oil from any ingrained dirt removes any residual moisture.

Oil storage

In large mills, the refined and dried oil is transferred to a tank for storage before dispatch from the mill. Because the rate of oxidation of the oil enhances with the temperature of storage the oil is usually kept around 50°C, using hot water or low-pressure steam-heating coils, to block solidification and fractionation. Iron contamination from the storage tank may happen if the tank is not lined with a suitable protective coating.

Kernel recovery

Large-scale mills use the recovered fiber and nutshells to fire the boilers. The super-heated steam is then utilized to run

turbines to produce electricity for the plant. For this reason, it performs economic sense to collect the fiber and to shell the palm nuts. In the large-scale kernel recovery method, the nuts contained in the press cake are separated from the fiber in a depericarper. They are then dried and fractured in centrifugal crackers to free the kernels. The kernels are usually separated from the shells using a combination of winnowing and hydro cyclones. The kernels are then dried before packing [6],[7].

3 WASTE GENERATION

Generally, we get crude palm oil (CPO) and palm kernels as the main products when producing palm oil in the palm oil mill (POM). However, it also produces vast quantities of residues such as fiber, nutshell, and empty fruit bunches (EFB). Every ton of CPO, discharges approximately 2.5 ton of palm oil mill effluent (POME), 0.9 ton of empty fruit bunches, 0.6 of mesocarp fibers, and 0.27 ton of shells. When we talk about waste generation, the raw POME can be considered as one of the most significant industrial pollutants having BOD, COD and TDS values as high as 26,000, 67,000 and 72,000 mg/l respectively [8] and also it consists of 0.6 - 0.7% palm oil, 95 - 96% water, 4 - 5% total solids, and 2 - 4% suspended solids. Approximately 20 - 22.5 tons of EFB is produced from 100 tons of fresh fruit bunches (FFB) [9]. For each kg of palm oil, approximately another 4 kg of dry biomass is provided; nearly a third of which is observed in FFB derived wastes, and the other two-thirds is represented by trunk and frond material[10], [11], [12]. In Sri Lanka for an example, about 18,000 MT of palm oil are produced every year by AEN Palm oil Processing (Pvt) Ltd. Due to this production, they discharge about 24 Million liters of wastewater via Madampitiya pump station. Moreover, about 9600 MT of EBF, 8160 MT of fibers, 1920 MT of nut shells and 720 MT of press cakes are produced as solid wastes [13]. As there is no industry-specific standard for the palm oil industry in Sri Lanka, the factories have to follow the General Effluent Discharge Standards specified by the Central Environmental Authority (CEA).

waste treatment:

The basic principles of waste management are to minimize and recycle the waste, recover the energy, and finally dispose of the waste. The oil palm manufacturing has always been linked to the environment because it is a land-intensive industry. Any unplanned growth will lead to the degradation of the forest systems, loss of habitats including plants and animals, severe land degradation and pollution (water and airborne) due to the use of large amounts of pesticides and herbicides needed to maintain the plantation [14]. Fibers and kernel shells use as boiler fuel in the mills, and usually, empty fruit bunches use to prepare compost for palm oil plantations. It is the easiest way to reduce solid waste generated on palm oil industries currently. POME is the liquid form of waste, and they generally treated at wastewater treatment section on the factory. In there, the acidity level of POME reduces and puts the BOD and COD values of wastewater on safe conditions, treated POME use as organic land fertilizers in Sri Lankan palm oil industries. As well some industries use POME to produce biogas as energy. After extracting oils from fleshes and kernels saved with residuals. Some industries use them to

prepare the animal feed. This helps to earn some extra money to their industries. These are the practices currently using in palm oil industries in Sri Lanka. According to our research, the AEN Palm oil site which we selected, that follows an excellent waste handling practices than other palm oil factories. So they do not produce any waste to surrounding and use waste for essential reasons for the factory and outside of the factory.

4 Impact of palm oil Industry

Oil palm plantation has been expanded rapidly in recent decades. This large scale land use change had important economic, ecological, and social impacts on both the areas turned into oil palm and their surroundings.

Social impact

The social impacts of palm oil production are very complicated such as, Land use rights-In some cases, the rapid increase of palm oil as with mining and logging earlier, resulting from using the many areas of land rights. The creation of large scale plantations has resulted in local and endemic peoples losing their land along with their traditional livelihoods and cultural reference. For example, National Land Bureau of Indonesia estimated that around half of the country's 8,000 land conflicts are within the oil palm sector in 2012 [15]. Labour rights- Workers, typically live in poor conditions without access to necessary facilities such as clean water. Child labor is a common problem in oil palm plantations in many countries. Children receive little or no pay and may be forced to endure harsh operating conditions, including long hours and exposure to toxic chemicals. This can be caused due to poor education and the lack of school facilities. In Malaysia, it is estimated that between 72,000 and 200,000 stateless children work on palm oil plantations [16]. Oil palm's ability to generate employment is minimal, and the jobs provided are of low quality in all aspects. Employment losses resulting from deforestation Loss of livelihoods -More than 50 million people depends on the forests for their livelihoods. So due to deforestation, it will reduce access to land for future generation as well as it is severely affecting the people who depend on the forests.

Environmental impacts

Deforestation

In most of the countries increased their cultivated area for oil palm. In Indonesia and Malaysia cultivated oil palm from 2.6 million hectares in 1990 to over 15 million hectares in 2014 [17]. In Sri Lanka also the oil palm cultivation expands to 20000 hectares. Also, there had an approval has been granted to 05 Regional plantation companies to import 259,000 seeds in the year 2017 of which 1356.37 hectares are to be cultivated [18]. Therefore this rapid expansion has resulted in oil palm being considered a significant contributor to deforestation. The current and forecasted (2080) forest area that will be vulnerable to deforestation due to palm oil plantation is given in Figure 4.

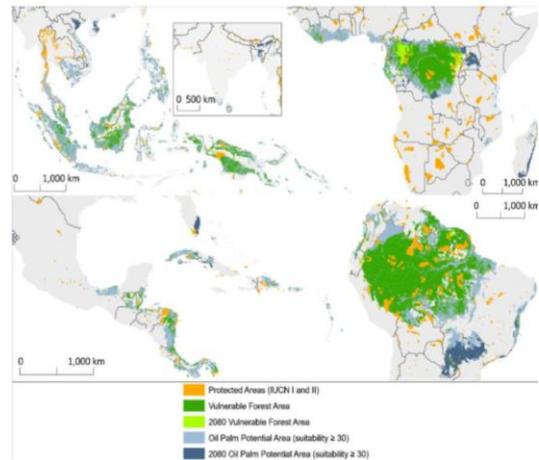


Figure 4: This is current and forecasted (2080) forest area that will be vulnerable to deforestation due to palm oil plantation [19].

Biodiversity loss

Palm oil tree is only growing in the biodiversity-rich tropics because of the tropical areas and its weather much more suitable for oil palm plantations. Due to oil palm development, there having significant negative impacts on global biodiversity as it typically replaces tropical rainforests and other species-rich habitats. Global palm oil production is affecting at least 193 threatened species according to the research [20]. The oil palm expansion could affect 54% of all threatened mammals and 64% of all threatened birds globally. In the previous section, we prove the evidence that the expansion of the palm oil industry has resulted in the deforestation, to the millions of hectares of forest to the plantation. So it also contributes to the loss of biodiversities such as wild pig, rodents, snakes as well as it also contributes to the loss of habitat of some species such as rhinos, elephant, and tigers. In another way, even national parks have been severely impacted.

Greenhouse gas emission and climate change

Palm oil cultivation also contributes to the greenhouse gas emission in two ways. Those are,

- Land use change

Tropical forests store at least 46% of the world's worlds' living carbon and 25% of total net global carbon emissions from deforestation. In Asian tropical rainforest store approximately 400 tons of carbon per hectare above ground and the additional carbon stored in mineral soils. Approximately 91 tons per hectare of aboveground carbon fully mature due to oil palm plantation. If forest vegetation were cleared with fire, compounds that have a net greenhouse effect equal to 207 tons

per hectare of carbon would be emitted, although some estimates are mostly higher than it.[21].

- **Plantation and mill activities**

In addition to land use change, some other factors contribute to the GHG emission such as treatment of palm oil mill effluent, fertilizer use for the plants, energy input to mills and fossil fuel use for vehicles, machinery and power generation during the day to day activities.

Air pollution

Burning is a standard method for clearing vegetation in natural forests as well as within the oil palm plantations. So that burning forests releases smoke and carbon dioxide into the atmosphere, this also causes to polluting air and also contributing to climate change. Fires in some areas are particularly challenging to put out. The smoke from these blazes has health consequences throughout southeast Asia [22].

Soil and water pollution

A palm oil factory generates 2.5 metric tons of effluent for every metric ton of palm oil it produces. This effluent directly releases, and it can cause a harmful threat to freshwater pollution, which affects biodiversity and people. While oil palm plantations are massive users of pesticides and fertilizers overall, the malicious application of these types of materials can pollute surface and groundwater sources. In terms of these things, there are some other factors which can affect the water quality such as runoff and sedimentation, leaching of nutrients from fertilizer, those things reducing water quality and making rivers shallower, thereby increasing flood risk.

Soil erosion

Erosions occur when forests are being cleared to establish the plants and also it may be caused by planting trees in inappropriate arrangements. The leading reason for erosion is the cultivation of oil palms on slopes. Erosion increases floods and silt deposits in rivers and ports. These Eroded areas need more fertilizer and other inputs such as repair roads and other structures.



Figure 5 : (a) newly established oil palm plantation in both sides of the waterfall and (b) Platform preparation for planting palm oil that leads to soil erosion in sloppy lands at Deraniyagala.

The environmental pollution by Palm oil industry is given in Figure 5.

Noise pollution

There has colossal noise pollution in Sri Lankan palm oil industries. AEN is the best example of that. We observed that outside and inside of the industry, there has much sound pollution. This is happening due to heavy machinery which is used to produce oil palm. Also, due to the transportation process, there having a significant possibility of produced colossal noise. Other impacts that we found during this study,

The threat to the rubber industry:

In Sri Lanka, there is no fixed land for the oil palm plantation. Therefore oil palm was replaced with the rubber tree. Not only Sri Lanka but also there are many countries replaced the oil palm with the rubber tree. So that depleting natural rubber production caused to huge break down in the Sri Lanka economy. According to the Coconut Research Institute has got itself engaged in the oil palm cultivation in rubber farms which will destroy both rubber and coconut manufacturing.

➤ **Absorbing water resource to the trees:**

Oil palm has high water consumption. So that is highly effective on the groundwater due to high evapotranspiration rate in during drought condition. Also, all areas which closer to the palm oil fields caused to dry soon. As well as wells are drying early. Other plants, animal and all niches which are grown in that areas get in danger due to this water scarcity.

➤ **There haven't timber value for the tree trunks compared to the rubber and coconut tree**

Value of the rubber and Coconut than the palm industry

Value of the rubber and Coconut than the palm industry Coconut industry itself is a spread area due to the subdivision

of the coconut plantations. Coconut tree provides many other uses other than the coconut milk. If the oil palm takes that position, it can only provide oil. Therefore, the government should take necessary action to overcome these problems. As well as a coconut tree, rubber also valuable than the palm tree. Rubber is a plant which had much demand after the 1st World War. But, Rubber has no proper market in this decade because of the artificial rubber. However, the rubber tree provides shade, and it prevents soil erosion. It provides firewood as well as timber. There have some significant advantages using coconut oil rather than using palm oil.

Coconut oil Vs. Palm oil

Coconut oil and palm oil are products of palm trees. Hence they are often referred to as the tropical oils. But they are very different in chemical, appearance, character, and composition. Even their influence on health is uniquely different

- Coconut oil comes from the seed of the coconut palm (*Cocos nucifera*), and Palm oil extracted from the fruit of the oil palm (*Elaeis guineensis*).
- The virgin coconut oil has a color of pure white, and the virgin palm oil has a color of deep orange-red.
- Vitamin E content of palm oil is relatively high and is about 2.17 mg on one tablespoon. When it compared with coconut oil, it is very less amount (include 0.01mg on one tablespoon), but Palm Oil has its relevant uses, in other sectors; also over consumption of palm oil might give rise to issues like obesity and weight gain. Palm and coconut have high energy content. One tablespoon of palm oil has 120 calories, while the same serving of coconut oil has 117 calories [23].
- Palm oils have its fatty acid composition (50% saturated, 40% unsaturated, and 10% polyunsaturated) Where coconut oil has around 90% MCFA's (fat your body can easily burn for energy) palm oil only contains around 50% MCFA's [24].
- Coconut oil helpful in weight loss, better brain function, and also useful for massage and moisturizing purpose. Palm oil may be free of trans fats but is high in saturated fats, which is bad for health, and there is no doubt. It's a glorified oil to hide its harmful effects, so the food companies easily use it to reduce cost. So the consumption of palm oil hazardous. The thing is all the good things becomes harmful if used in excess. So a proper and moderate consumption is always suggested for anything.

Suggestions:

In POM industry, there are lots of waste generations and environmental impacts, and there is a way to treat each problem separately. However, some waste treatment methods are not 100% successful and environmentally friendly. The

primary environmental impacts from the POM industries in Sri Lanka are the sound, air, and land pollution. They are some precautions to minimize those impacts up to a certain level. However, it has not become 100% successful. The proposing suggestions are needing to be environment-friendly, fit for the industrial economy, and also it should be affordable to Sri Lankan climatic changes. **Suggestion for sound pollution - When considering sound pollution, it can be observed on either outside of the industry or inside of the factories and also internal pollution cannot be reduced totally. However, if there is any way to reduce the friction of the machine up to a certain level, the sound can be reduced. So, by making walls and floor are noise friendly, sound can be reduced up to a certain level too. Floors can offer practical ways of reducing noise pollution. It depends on the variety of floor in place. Carpeting, for instance, normally reduces a substantial amount of noise but better results can be achieved by the use of noise friendly flooring like vinyl. Vinyl is a resourceful alternative to carpeting, and it is reducing noise pollution, and it has some sound absorption quality. Use of noise canceling device can also help humans to protect from sound pollution. Most Palm oil factories in Sri Lanka are using ear bud instead of head noise canceling headphones. AEN palm oil factory also uses ear buds to prevent noise pollution. Therefore those industries can replace ear buds with some headphone workers can protect their hearing ability up to more satisfaction level. Still, there is no any treatment method has been taken to minimize for the noise outside of any POM factory in Sri Lanka according to this study. They have not been considered it. By making rough walls around the factory and by growing trees very close to each other within the factory premises can be reduced the sound that emits from factories. Suggestion for air pollution - To reduce air pollution from flue gases released form POM factories are not been considered yet. The two most common ways POM factories can implement to decrease their air pollution emissions are:**

- **Optimizing the factory's operations**

Companies can optimize various parts of their operation to conserve energy, thus decreasing the facility's overall emissions. Destroying pollutants before they enter the atmosphere, Plant operators can also employ abatement mechanisms that help stop VOCs, HAPs, and other pollutants before they enter the environment. Different abatement techniques are efficient for specific types of pollutants, so you need to evaluate your operation to find the ideal technique. Suggestion for land usage - By adding a proper filtering system for the leaking oils and proper management of waste can prevent land pollution. The 3R concept can be implemented. Suggestion for land waste - A route to gain more energy from oil palm plantations is the more effective use of oil. Palm biomass other than the palm oil. There are no exact statistics for oil palm dry matter production. Such

statistics are only compiled for palm oil, palm kernel, and fresh fruit bunches. Rough extrapolations, however, can be made based on the estimations of the ratio of palm oil to other dry matter. For each Kg of palm oil, approximately another 4 kg of dry biomass is produced; nearly a third of which is found in FFB derived wastes, and the trunk and front material represent the other two-thirds. On an energy basis, the palm oil serves approximately a third of the biomass yield, as it has roughly twice the heating value of the other oil palm dry matter, which therefore amounts to nearly 2kg on a palm oil equivalent basis. Based on 2005 production, around thirty million metric tons of oil equivalent of non-palm oil dry biomass matter was available for energy production from Sri Lankan palm oil plantations, or in other words part of present entire primary energy demand. Only a little fraction of this potential was used, and that very inefficiently. Open burning is still too frequent and responsible for substantial air pollution problems in South Asia, showing that other solutions immediately need to be found. Some biomass is used for mulching and as fertilizer, though this use is limited by labor and logistical limitations and concerns about encouraging oil palm pests [25][26].

5 Conclusion

This research finding shows that high range of environmental impacts occurs due to the oil palm cultivation. With the help of CEA, and other scientist, it can be continued the palm oil production process more environmentally friendly sustainable way. The relationship between the palm oil cultivation and the ground water depletion has to be further analyzed. It can be concluded that is better to import crude palm oil and process to generate purified palm oil for the foreign market.

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