

Palm Oil - The Silent Killer

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Abstract : Palm oil was introduced to Sri Lanka later, and coconut oil was the traditional oil used in the country for centuries. But as the industries grow, the palm oil started to produce on a large scale. At the same time, it became an efficient and inexpensive oil which is widely used even as a bio fuel. Many traditional lands and forest areas were used during palm cultivation, and there have been many environmental and social issues such as deforestation and environmental pollution and violation of land rights. But coconut oil cultivations had posed fewer threats to the environment as it was naturally grown in traditional lands and can grow in any soil types. Simultaneously, it is easy to replace the trees than palm, and the coconut trees can exist for generations. This review article has discussed the impacts of Palm oil cultivation on highlighting the dark side of the golden fruit.

Key words: Edible Oil, Environmental Impacts, Health Impact, Palm Oil, Sustainable development.

1 Introduction

Palm oil is cheap and used in thousands of everyday products. It is the most widely consumed vegetable oil on the planet [1]. However, a massive area of the rain forest has cut down or burn to make way for palm plantation. So why this oil is still so cheaply and readily available?

There are two types of Palm oil production as crude palm oil and palm kernel oil. The crude palm oil comes from squeezing the fleshy fruit, and palm kernel oil which comes from crushing the kernel, or the inert part of the fruit. According to the statistics, of total world production, 5% is used for biofuels, 24% for cosmetics, and 71% by the food industry [2]. Palm oil is in every product from chocolate to bread, Instant noodles to shampoo. Even though we don't think about it, globally, we each consume approximately eight kilograms of palm oil annually. But even with closer look through the ingredients of your product, you may not be up to spot it. Because written on the back label, could see any of the palm oil-related compounds which are not easily recognizable as a palm oil family. As an example, Vegetable oil, Vegetable fat, Palm Kernel, Palm Kernel Oil, Palm fruit oil, Palmate, Palmitate, Palmolein, Glyceryl, Stearate, Stearic acid, *Elaeis guineensis*, Palmitic acid, Palm Stearine, Palmitoyl Oxostearamide, Palmitoyl tetrapeptide-3, Sodium Laureth Sulfate, Sodium lauryl sulfate, Sodium kernelate, Sodium palm kernelate, Sodium lauryl lactylate/sulphate, Hydrogenated palm glycerides, Ethyl palmitate, Octyl palmitate, Palmityl alcohol. Currently, Indonesia and Malaysia contribute to 85% of world palm oil production.

Oil palm is originated in West Africa. The trees were introduced to Malaysia in 1875. But for the hundreds of years, something was missing. Hundreds of thousands of workers with the limiting of efficiency were doing hard working for pollinating flowers by hand. Until in 1981, African Palm beetles were introduced to Malaysia. These little beetles pollinated the plants with no extra work for humans. Suddenly, palm oil yield boomed. Since this palm oil popularity has done nothing has raised. At the time which companies realized the negative health implications of the trans-fat found in many process products could be replaced with palm oil-based products. However, this incredible rise of the demand for palm oil caused by the expansion of the palm oil plantation led to the destruction of the vast area of tropical rainforest. That creates the devastating condition

with CO₂ emissions and destroying the remaining habitats that already in danger species. Fig. 1 represents the rain forest area removed for the palm oil plantation.



Fig. 1. Rain forest cleaned for the palm oil plantation in Indonesia [2]

Palm oil extremely cheap, itself stable, it has natural preservative qualities, it is perfect vegetable oil, but the fact is it has been grown in the way that cost lots of environmental damage. Palm oil is more efficient than alternative oil sources to grow in the land, which takes ten times the land requirements. Oil palm trees evergreen and produce fruit all the year and happily grow in the soil many other plants can't. The fresh palm fruit is shown in Fig. 2.



Fig. 2. Palm fruit [3]

NGO and companies around the world came together to set up the round table in 2004 to create a set of criteria to grow this product sustainably. But it only since 2018 the round table has decided to completely keep palm oil deforestation-free. Fixing this problem isn't going to be easy now. There is a varying level of government support in different regions, and the extent of government support to identify whether the company can produce without deforestation. SO ARE WE DOING ENOUGH? We are running out of time. India, China and Indonesia will count for nearly 40% of the palm oil consumption.

2 Impact on Rainforest

The concept of sustainability defines as the "meeting the needs at present without compromising the needs of future generations. The sustainability principle is even applicable to the food manufacturing industries. It can be stated as the "sustainable food system as a food system that ensures food security and nutrition for everyone in such a way as not to put at risk the economic, social, and environmental foundations that help provide food security and nutrition to future generations" [3].

The Food and Agriculture Organization (FAO) proposes the following principles of sustainability for food systems to overcome this issue [4]:

- Management and conservation of natural resources.
- Efficient use of natural resources for production.
- Protection of rural livelihoods.
- Improvement of equity and rural welfare.
- Building the resilience of individuals and communities.
- Establishment of accountable and effective governance mechanisms, strengthening institutions and investment.

The sustainability of the oil palm cultivation is a primary issue even today. However, in the year 2004, initially discussed that concept as a roundtable discussion to minimize and maintain palm oil production in a sustainable way. The main objective was to protect the environment in the place where it is produced. Even though many different EU nations are using palm oil for biodiesel production as renewable energy, it causes huge environmental pollution in the place of origin. The lines of actions of the summary of the round table discussion are listed below in Table 1 [5]. However, even today, after sixteen years of the table discussion, a problem not being solved.

Table 1. Roundtable for Sustainable Palm Oil (RSPO) [5]

Principle Number	Principle
1	Behave ethically and transparently
2	Operate legally and respect rights
3	Optimize productivity, efficiency, positive impacts and resilience
4	Respect community and human rights and deliver benefits
5	Support smallholder inclusion
6	Respect workers' rights and conditions
7	Protect, conserve and enhance ecosystems and the environment

According to the previous well known studies, oil palm plantations are not just encroaching on rainforest, they are also contributing for degrading water quality. It has summarized that the water streams flowing through oil palm plantations were at higher temperatures and with high amount of sediments and more oxygen compared to the other areas. Therefore, that will cause potentially significant impact on the people living nearby areas [6].

Global palm oil consumption is approximately around sixty million tons per year and still rising. Since the world is committed to depend on Biofuels to reduce the amount of fossil fuel consumption, developed countries are now with around five per cent of Biofuels, which derives from edible oil for their transport sector. Biofuels discussion has risen with the reduction of environmental pollution and sustainable development, caused by the mass destruction of the rain forest to generate high global demand of raw palm oil for biodiesel generation. It is not just the European Union take actions for Biofuels, the massive palm oil cultivated country, Indonesia itself promoting biofuels usage within their country. Air pollution level drastically increased in the Indonesian territory by growing causes of death with the effects of smoke poisoning—deforestation through slashing and burning to reach an unprecedented scale. Even the Indonesian government has permitted the destruction of millions of hectares of rainforest to scale up the palm oil cultivation to reach the global demand. In Indonesia already 2.6 million hectares of rainforest the same size as Belgium has destroyed to fulfil the palm oil requirements. We cannot wash our hands by telling it is Indonesian rainforest. To meet our grocery items which depend on palm oil, someone has to lead with supplying the raw material. Therefore, it is our responsibility to prevent this massive destruction. The pressure is mounting to expand the cultivation as demand is drastically rising all over the world. One of the main reason for the large-scale destruction of the rainforest is biofuels concept of Europe. That single reason led to the massive destruction of the rain forest, which is similar to the size of Switzerland. More than 20 Indonesian companies are currently operating their palm oil production by adding large quantities of toxic into the drinking water supply streams as wastewater. Billions of Euro receiving as an investment for palm oil cultivation has shut the government voice of destruction of the rain forest. Immediate action has to be taken for the European concept of Biofuels to stop production of Biofuels using edible oil instead of using non-edible oil or waste cooking oil.

In the year 2018 at the proposal for Renewable Energy Directive for 2021-2030, EU member states concluded that to reach carbon emission reduction in the energy and transport sector by each member states. Therefore, many of the nations are shifting to Biofuels by reducing fossil fuel consumption within their countries. That will help them to reduce their carbon emission by increasing carbon emission at the place where raw materials of biofuels are manufacturing. In that case, what is the purpose of having a carbon footprint concept if we act as an individual nation? Now time is come to implement a global level carbon footprint solution, not just thinking our environment is free with carbon emissions by destroying someone else home. It is useless to achieve low carbon emission at our doorstep by improving high carbon level, destroying rainforest and water streams in the other corner of the planet. Because in the end, this is the only planet habited right now and its matter for everyone.

3 Health Concern of Palm Oil

Palm oil contains many foods like chocolate, bread, sauces, ice cream, baked goods, cookies, peanut butter, and even food for pets. Other than that, palm oil also plays a vital role in the manufacture of candles, cosmetics, laundry detergents, personal hygiene such as conditioners, soaps, toothpaste, shampoo, and much more. So it is tough to avoid this product altogether. Traditionally palm oil was used as a cooking oil in West Africa, South Asia, and Brazil. But today, palm oil is the most widely consumed vegetable oil in the world. Global annual palm oil consumption exceeded 70 million metric tons in the year of 2018/19. Nearly 70% of palm oil is used in foods (Fig. 3), and others are used for industrial uses, including biofuels production and cosmetics.

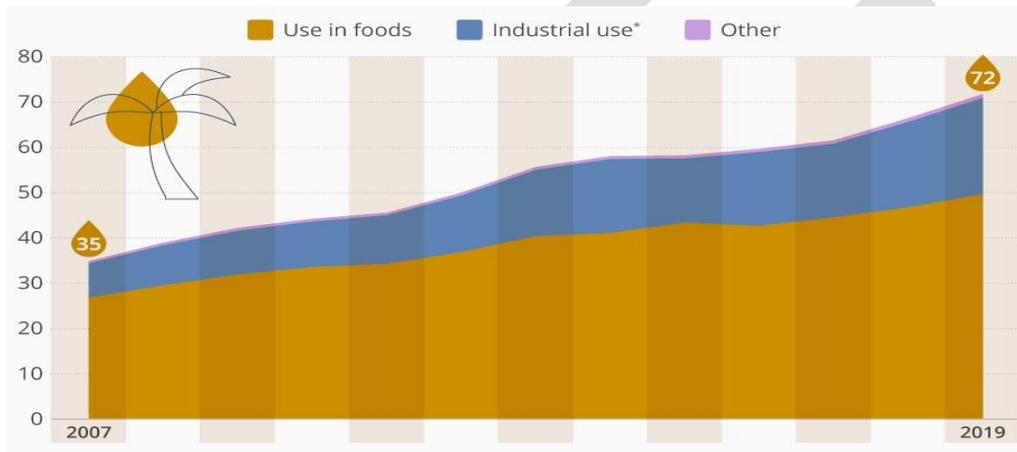


Fig.3. Worldwide Palm oil usage: 2017-2019 [7]

Other than that, Sri Lanka's domestic palm oil consumption also rapidly increased in the last few years. By the year 2019, Sri Lanka domestic palm oil consumption was around 240 MT (Fig. 4). Almost all of them are in our daily routine food products.

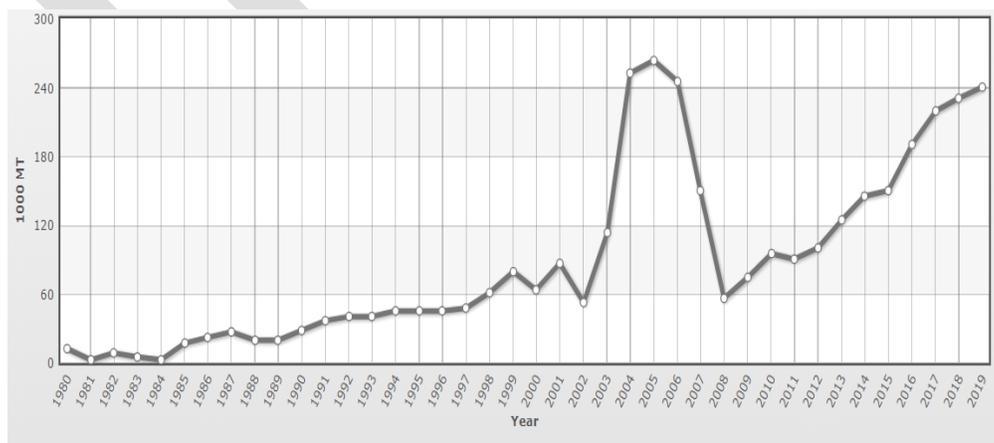


Fig.4. Sri Lanka Domestic Palm oil consumption by Year [8]

Palm oil has a unique and balanced chemical composition of saturated fatty acid and unsaturated fatty acid. It consists of nearly 44% saturated Palmitic acid, 40 % monounsaturated oleic acid, 10 % polyunsaturated linoleic acid, and 5% saturated stearic acid [9]. Due to its unique composition, there are several health risks and benefits as well. Due to the high amount of fatty acid contains in palm oil, and long-term consumption of palm oil can lead to heart attacks, myocardial infarction, cardiovascular diseases (CVD). It creates blood clots, and give very high cholesterol. This effect contributes to increased coronary heart disease (CHD) and death [10].

According to the world health organization, 17.9 million people die each year from CVDs, an estimated 31% of all deaths worldwide, and more than 75% of CVD deaths occur in low and middle-income countries. 85% of all CVD deaths are due to heart attacks and strokes [10]. Other than that, according to the mortality of Sri Lanka, 40% of CVD deaths (Fig. 5) are estimated in 2017 [11].

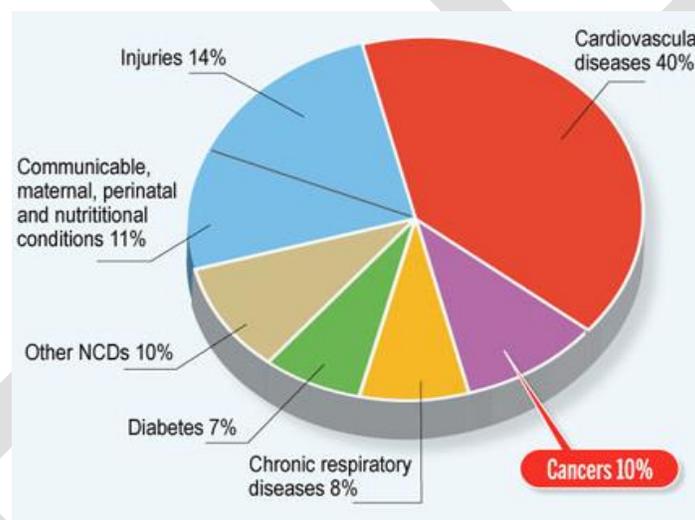


Fig.5. Causes of mortality in Sri Lanka-2017[11]

Excessive trans fats in the diet cause a significant risk factor for cardiovascular disease. Some researchers also found that excess consumption of trans fatty acid can cause breast cancer and even some risks associated with diabetes as well [12]. Palm oil also has some side nutrient benefits because of the composition of carotenoids and tocotrienols. Carotenoids are potent antioxidants that help to body immune system and reduce some amount of risk of cancer. Other than that, tocotrienol is also another form of Vitamin E, and sometimes it helps to blood flow to the brain and skin protection as well. In addition to that, they improve cognition and bone health [13]. It's beneficial to consume no more than 2 TBSP of palm oil per day to avoid possible adverse effects.

4 Comparison with Coconut Oil

There are many similarities and dissimilarities between coconut and palm oil in aspects such as production methods, chemical properties, physical properties, nutritional value and health effects. Therefore, this study aims to compare coconut oil and palm oil for the above features and discuss their suitability for consumption and production.

Comparison of the production process of coconut oil and palm oil

Coconut oil extracts from the coconut kernel. It can be extracted using several methods such as extraction of Virgin coconut oil obtained from wet coconuts, Extraction of Unrefined coconut oil from dry coconuts/copra and solvent extraction. When wet coconuts are used, they are pressed along with coconut milk which is processed afterwards without using heat, steam and chemicals for refining. This product is known as virgin coconut oil. When copra is used, it is pressed using continuous or hydraulic pressers to extract oil. This is an unrefined form of coconut oil, and it can be refined by heating. In the conventional method, freshly extracted coconut milk is centrifuged to obtain coconut cream. Then it is heated in digester tanks up to 60-80 Celsius to release the oil. Then this oil can be separated using a further centrifugation step.

The solvent extraction method is a new and commonly used method to extract coconut oil. This method gives a higher yield than the above aqueous extraction methods. Here solvents are applied to copra subsequently to maximize the extractability. Palm oil extraction consists of more extensive processing than coconut oil extraction. Palm oil is extracted from fresh palm fruits. Sometimes palm kernel is also used to extract palm oil. Mainly fresh palm fruits are used in Sri Lanka. During this process, initially, the palm fruits are sterilized using steam. This is done before threshing. Sterilization can also be done after threshing. But there, smoke is used for this purpose. After that, threshing is done.

Next, the palm fruits are passing the process known as threshing, in which each piece of fruit is here each fruit is separated from the fruit bunch. After threshing, the palm fruits are pressed in order to separate the oil from the skin and the pulp. Heavy metal plates mechanically press the fruits to squeeze out the oil. Then the impurities are removed by diluting the oil with water and filtering through a screen to remove impurities and debris. This product which is considered as low-quality palm oil, is known as edible crude oil. It can be refined by further processing. For that purpose palm oil refining process and palm oil, fractionation process are done. During refining, harmful impurities and unwanted substances are removed in order to get the standard edible oil. These processes utilize physical and chemical methods. During fractionation, high-quality oil is separated from low-quality oil by heating. High-quality oil consists of a high amount of essential fatty acids but less saturated fat than crude palm oil [14].

Comparison of physicochemical properties of coconut oil and palm oil

At present several types of research have been done to compare palm oil and coconut oil in terms of physicochemical properties such as iodine number, saponification number, viscosity, colour and the amount of free fatty acids. Coconut oil and palm oil are both vegetable oils obtained from trees belong to the palm family. Both contain high amounts of saturated fatty acids, and they are excellent cooking oils because of their high resistance to oxidation. They can also be found in the solid form at cooler temperatures, and both have high melting points. These are the main similarities between coconut and palm oil. But the dissimilarities are more, and they are discussed below. These oils in their pure form can be easily differentiated by their colour. Virgin coconut oil (VCO) is pure white in colour, whereas palm oil has a yellow-orange colour. Virgin palm oil has a deep red colour.

The melting point of coconut oil is 24 degrees Celsius. But palm oil does not have a sharp melting point like coconut oil. In contrast, palm oil has a gradual melting point which means it can be a solid or a liquid or both within a range of temperatures. Sometimes in palm oil, there can be a mottled appearance of different colours from light orange to dark red. Fig. 6 and 7 show the physical appearance of virgin coconut oil and palm oil at room temperature, respectively.



Fig 6. Virgin coconut oil



Fig 7. Palm oil

The difference in the melting point between virgin coconut and palm oil is due to the difference in their chemical composition. These oils consist of fatty acids. When considering different types of fatty acids, there is a significant difference between their amounts in coconut and palm oil. When free fatty acid content is compared, it is found that VCO contains a high amount of lauric acid and stearic acid than palm oil. A high amount of Palmitic acid is present in the Palm Oil. Also, Virgin Coconut oil has comparatively higher acid numbers and saponification numbers but relatively lower iodine number than palm oil. A comparison of the acid number, saponification number, iodine number and the FFA% (free fatty acids) is given in Table 2 [15].

Table 2. Parameter comparison of Palm Oil and Coconut Oil

Type of oil	Acid number	Saponification number	FFA%	Iodine number
VCO(A)	1.01	348	0.26	5.32
VCO(B)	1.03	345.7	0.25	5.24
VCO(C)	1.022	346.64	0.26	5.25
Coconut oil	0.39	269.62	0.28	7.02
Palm oil 1	0.39	204	0.51	51
Palm oil2	0.39	203.02	0.73	49.71

Recently ageing studies also have been done for of coconut and palm oil in the presence of insulating paper for transformer application. There, it was revealed that alternating current, breakdown voltages and relative permittivities of coconut oil and Refined Bleached Deodorized *Palm Oil* (RBDPO) do not significantly change with ageing. But the resistivity has a slight increment with ageing for coconut oil while all types of RBDPO have shown a slight decreasing trend of resistivity with ageing. An apparent decrement of the dielectric dissipation factor with ageing was shown only by coconut oil. Acidities of both coconut oil and RBDPO remained at a low level, and the moisture decreased as the ageing proceeded. And both the oils have retained more than 50% of their tensile index even at an ageing temperature of 130°C. The rates of paper ageing of both oils significantly increased at an ageing temperature of 130°C [16].

Comparison of the nutritional value of coconut oil and palm oil

Coconut oil and palm oil are excellent energy sources. Burning of 100g of oil gives about 878-884 calories of energy. Virgin Coconut oil has about 92% saturated FA, 2% polyunsaturated fatty acids, 6% monounsaturated FA. And nearly 63% of fatty acids are medium-chain fatty acids. Although coconut oil is rich in saturated fatty acids, it provides a negligible amount of micronutrients such as vitamin E (0.2mg), Vitamin K (5Microgram), Iron(0.5mg and Phytosterols (86mg) per 100g of oil. Palm oil contains very fewer amounts of medium-chain fatty acids (0.5%). According to the above data, coconut oil has more saturated FA than palm oil. And palm oil has more monounsaturated and polyunsaturated FA than coconut oil. Unlike coconut oil, palm oil is rich in phytonutrients such as carotenoids, vitamin E, Squalene, sterols, phospholipids, Coenzyme Q10 and polyphenols [17].

Comparison of the health benefits and risks of coconut oil and palm oil.

Both coconut oil and palm oil are rich in saturated fatty acids. Therefore, there is a belief among the society that consumption of these oils can subsequently lead to obesity, high cholesterol levels in blood high blood pressure, and increase the risk of coronary heart disease. Excessive consumption can also lead to diabetes mellitus and cancer.

Virgin Coconut oil can protect against several chronic disease conditions, and it is known to be cardio protective. The reason is that coconut oil has more medium-chain fatty acids (MCFA) than palm oil. And the MCFA are found to be not synthesizing and transporting cholesterol because these fatty acids are directly absorbed from the gut, directly sent to the liver and rapidly used for energy production in the body. Virgin coconut oil also can reduce blood pressure.

Another interesting fact is that unlike palm oil, the VCO also contains lactic acid bacteria such as *Lactobacillus Plantarum* and *Lactobacillus paracasei*. They can inhibit the growth of some pathogenic bacteria such as *Pseudomonas aeruginosa*, *Klebsiella*, *Staphylococcus aureus*, *Escherichia coli*, *Listeria monocytogenes*, *Bacillus cereus*, *Salmonella typhosa*, *S. epidermidis*, *Proteus* and *bacteriocin*. Also, coconut oil has an antiviral effect as well. For example, it can act against several lipid-coated viruses such as influenza, virus, leukaemia virus, visna virus, and hepatitis C virus by disrupting their cell membranes and interfering in their reproduction cycle. Coconut oil can also help to obtain healthy skin, improve wound healing and therefore has a cosmetic value too.

Palm oil is more abundant in phytonutrients than coconut oil, as mentioned in the previous section and therefore has many health benefits as well. Carotenoids can synthesize Vitamin A, which prevents night blindness and maintain the health of connective tissues in the body. Vitamin E can act as an antioxidant. Sterols act as precursors for several hormones. However, when compared with coconut oil, palm oil has properties which make it more suitable to convert into diesel fuel rather than using it as a dietary oil [17].

5 Conclusion

The global consumption of palm oil invariably increases until 2050 as we approach 9.6 billion people. The broader market, such as China and India, considers the price rather than the sustainability product development. It looks like palm oil is going to be cheap for a while longer. But the cost of the planet will be devastating. But it is not just palm oil is the problem, Cattle, beef production plays the dominant role of deforestation. Soy, Palm, Cattle, and Timber are the main four categories of deforestation responsible sectors in the world. The company has the responsibility of sustainable product development not to wait for the consumer to make the demand; they have to make before the consumer demand. Palm oil is simply a silent killer.

As discussed in this paper, the production of palm oil the palm fruit is extensively processed with many sterilization and heating steps. It may lead to alterations in the nutritive value. This is mainly because heat treatments can stop enzymatic activities and arrest autoxidation and hydrolysis processes. But Virgin coconut oil is produced from coconut milk obtained by fresh fruits, and the process does not contain excessive heating. It mostly uses natural fermentation and enzymatic processes. This result in coconut oil with preserved natural nutritive value. There is a question about the sustainability of the palm oil industry when compared to coconut oil. Therefore when considering the excellent nutritional, health benefits and environmental friendliness and sustainability, it can be concluded that coconut oil is a better option than palm oil for dietary usage and for commercial purposes and a mean of the uplifting economy and the health of the country.

The cleaning of rainforest to plant oil palm trees leads to a massive amount of greenhouse gas emissions such as carbon dioxide. It directly effects on wildlife habitat by replacing a single crop in the natural forest ecosystem. Deforestation of the wonderful rainforest will take the responsibility to provide the land requirements. The destroy of the rain forest is not a reversible process. Isn't that enough to take immediate action to monitor sustainable product development? Else, our children or grandchildren will have to live with the curse we are dealing with and leaving behind today. We should take immediate action to educate the people, establish new rules and regulations to stop rainforest depleting, stop the clearing of other croplands which use less amount of water and less pollution. We have already well-established organizations to handle the situation. We have already destroyed the ecosystem, food system, and natural systems for short term benefits and the benefits for the minority. Normal practice is that once systems destroyed such additional costs transferred back to the public.

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