



Replacement of Essential Agricultural Crops to Reduce Impacts of Palm Oil Plantation in Sri Lanka

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Abstract: As a result of the industrial revolution and economic development, palm plantations spread from West Africa to South and East Asia. Palm oil was introduced to Sri Lanka in 1967. Palm plantations are covering around 20000 ha beginning in 2014. As a result, that causes the early drying of wells and waters in the dry season in oil palm-cultivated areas. Therefore, five essential economically practical alternative plantations are suggested in this article. Those are trying to apply to the abundant palm plantation lands, already cultivated and obtaining harvest. The government gazette to reduce and removing palm plantation lands to reduce 10% in 2020. This paper includes plantation and maintenance methods for some selected alternative plants, which helps the landowner as a solution to solve this problem by reducing environmental facts. So, five alternative plantations have been suggested to be used with palm residue management methods with organic fertilizer generation in some coastal areas.

Keywords: Atherosclerosis, Bioactive, Horticultural, Intercrop, Lateral roots, Musaceae family, Phytonutrients, Succulent, Waterlogged.

1 INTRODUCTION

The Oil Palm has spread from West Africa to South and East Asia due to the industrial revolution and economic expansion in Sri Lanka. Palm oil was introduced by Malaysia and started the first plantation in Sri Lanka around 1967 [1]. It then spread quickly in the southern part of Sri Lanka as a highly economical and profitable crop. There are currently several palm oil fields in Sri Lanka, but there are only two oil extracting industries in Sri Lanka. Palm plantation and palm fruit bunch are representing in Fig. 1 and 2. There are 12 to 15 bunches per annum in a healthy oil palm tree [2]. Palm bunches usually grow up to 10-25 kg in weight. When the quantities of fruit are mature, they become maroon in orange. They can extract oil [2] and transform it into a versatile and essential vegetable oil used for cosmetics, food, detergent, shampoo, and biofuel. There are palm plantation lands (abundant palm plantation lands, already cultivated and obtaining harvest) in Galle, Matara, Kalutara, Rathnapura, and Kegalle districts, where palm growing is visible and primarily influenced by socioeconomic changes caused by the population of palm trees. The result is increased farming in suitable areas and land abandonment, and also creating a biodiverse environment.



Fig. 01. Palm Plantation



Fig. 02. Palm Fruits [1]

However, Sri Lankan landowners farm that trees in their lands to get profit from oil extraction. Under a cabinet called taken in 2014, palm oil plantation extent was dilated by 20,000 ha, and those palm land's harvest generated 80,000 MT of edible oil. However, in 2020 Sri Lanka's President had banned the import of palm oil, and plantations companies would be required to uproot trees in the field 10 % at a time and plant rubber [2]. As a result of removing abandoned oil palm plantations and palm plantations of obtaining harvest need to replace effective alternative plantations, this paper aims to propose planting plantations such as Coconut, Rubber, Cinnamon, Pepper, and Tea. Each one will be selected to cultivate according to those places' climate. Therefore, instead of using old palms to support the development of more productive efficiency, it evaluates the effectiveness of suggested essential crops.

2 REASONS FOR PALM OIL PLANTATION IN SRI LANKA

Since 1967, Oil Palm has only been used to produce cooking oil in Sri Lanka. As a result, it has an assurance that all of the production of Oil Palm cultivation is used for oil production because they do not have any other been meant in our culture like the coconut. In Sri Lanka, the land is scarce. For example, if the required 80,000 MT of oil were produced using coconut, it would require approximately 80,000 ha, whereas Oil Palm would require only 20,000 ha because Oil Palm has 4x times the land productivity than coconut. In comparison, Oil Palm far outperforms its competitors, producing 59.4 million MT or 42.3% of the total global requirement for vegetable oil – using only 14.8 million ha of land, which is only 8.3% of all land globally used for cultivating crops for vegetable oil [3]. The cost of production (COP) of edible oil is essential to consider its feasibility in the market. Comparing to other edible oil like coconut, the cost of production is much lower in Oil Palm production. COP of Oil Palm is around Rs. 15 per kg of fresh fruit bunch (FFB), and COP of coconut is around Rs. 15 per nut. While coconut generates Rs. 175,000 per ha per annum, Oil Palm causes Rs. 514,000 per ha per annum [3].

3 IMPACTS OF PALM PLANTATIONS

- 1) **Deforestation:** The cultivation of old oil palm has numerous adverse effects. Sri Lanka does not have forests to cultivate oil palm like Malaysia and Indonesia [4], where oil palm is responsible for massive forest destruction. The remainder of the forest is highly critical and is mainly under the Department of forest and wildlife. Even the rest of the Land Reform Commission's lands are very crucial and sloping wildlife habitats. Thus, in Matara, Galle, and Kalutara, Kegalle and Rathnapura began planting rubber and oil palm plantations.

- 2) **Destroying the rubber industry:** The majority of the Oil palm manufacturers are own rubber plantations as well in Sri Lanka. However, due to the miss administration and lack of attention from the Sri Lankan Government, the Rubber becomes unprofitable for the companies involved in the plantation. There is less market value for rubber latex, and imported latex from Malaysia has overtaken the market. Sri Lanka currently imports close to 55,000 metric tons of crude Rubber and latex annually. Rubber planters now prefer to transform the rubber plantations into more economically viable petroleum palm plantations [5]. The result is that in most of the areas, there are old, abundant palm plantations.
- 3) **Destroying the coconut industry :** The ingredients in indigenous Sri Lankan coconut are essential. Coconut covers about 20%, nearly 400,000 ha of Sri Lankan arable lands. In 2017, Sri Lanka's coconut production dropped by 18.6% annually by 3 million nuts and 2.449 million nuts in 2018 [6].
- 4) **Destroying the water system :** Oil palm plantations degrade the quality of the water, according to the research. The research carried out by the U.S. and Indonesian scientists compared the characteristics of streams draining ripe and immature palm oil plantations, agricultural forest areas, and logged and old-growth forests. They showed that streams from oil palm plantations were hotter and dirtier than other areas and consumed more oxygen. In drought years, the impact was exacerbated. "Our results show that the use of palm oil can have a higher impact on the river temperature and sediment than mixed agriculture and agroforests," Carlson explained. "Our conclusions suggest that converting forests into palm oil plantations can be virtually so harmful to stream forests and diverse smallholder agricultural areas as clearing intact forests." The biodiversity of streams is affected by this situation.
- 5) **High water footprint :** High water consumption in palm oil and high evaporation levels (500 - 600 L/day) in drying conditions have increased effects on the groundwater and the typical average day is 400 L [4]. Thus, oil palm has an extremely high impact. The flood of the water varies from climate, soil, and palm-oil growth characteristics to soil conditions. Thailand's oil palm plantations had smaller quantities of indirect blue water. Average water sprint of 5083 m³ for a ton of seven mills. The following effects of farms on the local ecology of the water cycle could result in lower water availability, low-period discontinuous water flows, higher droughts, and natural ecosystems like wetlands being modified or eliminated.
- 6) **Disruption in the nutrient cycle :** Soil inequalities in plantations occur between root-absorbing nutrients and those returned by dead organic matter to the system. The action of degrading agents such as fungi and bacteria are often reduced in trees such as eucalyptus and pine. The nutrients in the litter are not liberated in a form that allows them to be consumed by the roots. Chemical changes, such as soil acidification and the introduction of new chemical compounds, make life for many components more complex and have other impacts on moisture, temperature, and lights. Some decomposers can disappear as well. The litter contains tannins, lignins, oils, wax, and other materials which are not easily digestible and even toxic to soil flora or fauna. They tend to build upon the soil and are known to take up to three to four years to decompose the leaves of the exotic pine. The ground becomes more insufficient for pulpwood plantations in direct connection with growth rates and declining rotations. Fast growth combined with the slow decomposition of litter means that trees extract nutrients more quickly than replace them.

4 SUGGESTED ESSENTIAL PLANT CROPS

4.1 Coconut Plantation

The majority of the coconut grows in the triangle formed by Puttalam, Kurunegala, and Gampaha. The area encompassed by these three towns is known as the Coconut Triangle. Coconut plantation is representing in Fig. 03. As well as the economic field in Sri Lanka occupies an important role. It helps employees achieve their brutal domestic product, foreign exchange, state revenues, and sustainable social-economic benefits. The Coconut Growth Board is the Ministry for Coconut's extension and offers a subsidy scheme, financial incentives, necessary inputs, advice, etc. Almost every coconut palm part is financially advantageous, and coconuts are representing in Fig. 04. The trunk is used to manufacture pillars and rafters for the construction of industry. The ankles are used to make sprouts, and the tissue is made from seasoned leaves. You can season and tap the inflorescence to get sweet kids. For fibre and shell products, husks and shells are used. Copra is used for the coconut crop. Most copra utilized oil, and nearly half of the oil produced is consumed domestically in cooking oil and industrial inputs. Coconut was the third biggest export earner after Tea and Rubber, which are providing foreign exchange and tax revenue.



Fig. 03. Coconut Plantation



Fig. 04. Coconuts

In 1982, the reported coconut area in Sri Lanka was 419,580ha (1.036 million acres). Coconut is only a second to low land rice in terms of land use in Sri Lanka, accounting for 22.6 % of the country's agricultural land, while rice accounts for 42.2 % of cultivable land. Coconuts have long thrived in villages along Sri Lanka's coastal regions. The Sri Lankan coconut farming system's physical, biological, and endogenous elements include climate, soils, water, location and distance, farm size, family labour, management skills, and availability. Coconut farms, more significant than 20 ha of land, are considered plantations in Sri Lanka. This plantation is managed by state organizations that include managers and workers. However, due to limited lands and resources, most coconut plantations are medium in size. The cultivation before 2 - 12 acres – or 20% of the total area – is primarily subsistence home gardens. Another statistic is that 27 % of cultivations are in large plantation areas [6].

4.2 Rubber Plantation

Rubber (*Hevea brasiliensis*) Nevertheless, the selected land for planting should meet specific standards to achieve the best possible results. The first commercial rubber cultivation in Sri Lanka in 1883 and rubber cultivation is rapidly increased in Sri Lanka during the first couple of years of the 20th century. Given the timber industry's growing interest in rubberwood, the rubber tree has become known as both latex and a timber tree for dual uses. Therefore, the emphasis is directly on breeding and selecting fast-growing trees

suitable for the production of latex and wood. On the other hand, the technical characteristics of the natural rubber produced by various clones, as industrial crops, should be improved to address the industrialists' future needs. The Rubber tree is a unique crop. It makes an extensive industrial raw material that has a more significant impact on modern life than any other commodities, is environmentally friendly to grow, and is a source of income to more than 20 million families globally, most of which are low incomes and landless. Fig. 05 is representing a rubber plantation.

The world's majority of natural rubber is produced in small-scale holdings, representing 83% of the 9.5 million ha in the rubber field. Sri Lanka's smallholder sector accounts for 32% of the total of 197,000 ha of rubber defined by the population as holdings of less than 4 ha in 1992 [7]. In particular, the importance of rubber in providing a secure and sustainable source of income, particularly when incorporating traditional short-term subsistence and cash crops, has been demonstrated recently in Sri Lanka. Due to its adaptability to the topography, soil, crop systems, low input capital, relative ease of latex harvesting and storage, and long-lasting safety in terms of income, theft, pests, and harm, rubber is ideal for farmers and smallholder producers. As a job supplier, the Rubber sector plays a crucial role in preserving the socioeconomic fabric for rural communities and the country as an employment supplier for approximately 500,000 people in Sri Lanka.



Fig. 05. Rubber Plantation



Fig. 06. Rubber milk

In the past, rubber has been cultivated as a monoculture on large estates. In recent years, though in this rubber intercropping, smallholders have been the predominant cultivator. In addition, the fast population growth in North-Rhine/Romanian producing countries has led to a gradual reduction of land holdings resulting in increasing pressure on smallholder producers to maximize land productivity. Many plants and trees, including food, cash, medicinal plants, and wood and fruit trees, can be found on smallholder Rubber plantations. Many other native plants and animals have proven to coexist with rubber. Although biodiversity is not close to rain forests, and developing a relatively rich forest mix of smallholders' rubber plantations is also possible.

Breeding and providing a long-term canopy that protects the earth from erosion by wind and rain also contribute to preserving the soil's area, depth, and durability. Trees like rubber play a significant part in keeping their land and water resources and thus helps to bind and protect the ground. Trees' littering adds organic matter to soil that enhances its surface properties, increasing precipitation infiltration and reducing

surface runoff. Rubber has become the primary alternative timber source in major NR-producing countries, reducing the pressure for logging on natural forests and teak plantations. Almost the wetland in Sri Lanka has already been rubber-grown. However, rubber's environmental and economic features can still be exploited to protect existing forest resources in Sri Lankan dry/intermediate areas. Fig. 06 is representing rubber milk collecting to the coconut shell.

4.3 Cinnamon Plantation

Best Cinnamon is the dried bark of a perennial tree with spirally arranged, broad laminated dark green leaves with palmate venation native to Sri Lanka. The plant can reach a height of 10 - 15m and a 30-50cm circumference[9]. Cinnamon has a land area of 25,500 ha in Sri Lanka. It is a member of the "*Lauraceae*" family and is classified as "*C.zeylanicum*." Cinnamon has initially been grown wild in Sri Lanka's central hill country, where seven different species of Cinnamon can be found. Commercially, only *Cinnamomum zeylanicum* Blume is grown.



Fig. 07. Cinnamon Plantation



Fig. 08. Cinnamon Plant

Fig. 07 is representing the Cinnamon plantation, and Fig. 08 is describing the Cinnamon plant. Cinnamon has been classified based on the flavour of the bark, with "Pani-Miris Kurundu" being the sweetest. It is currently grown along the coast from Negombo to Matara, Kalutara, and Rathnapura. Cinnamon has spread to the country's interior, where elevations can reach 250 meters above sea level. The wet zone is ideal for the growth of Cinnamon. It is not, however, appropriate for areas with prolonged dry periods. Cinnamon is a sun-loving plant that requires plenty of sunlight. A temperature range of 25°C to 30°C is ideal for a successful harvest [9]. Sri Lanka exports approximately 85 % of the best Cinnamon to the international market, making it the world's largest cinnamon exporter. Cinnamon bark is commonly found in quills (unique to Sri Lanka), chips, and featherings. Cinnamon is the only plant that contains essential oil in its leaves, bark, and roots, but its chemical compositions are entirely different. Cinnamon is also available in pure ground or as an ingredient in curry mixtures and pelleted form and is primarily used in cooking and baking.

4.4 Pepper Plantation

Call the "King of Spices," Pepper is one of the oldest known spices and is widely used and highly valued in

the international spice trade. Pepper is one of the world's most popular spices. Pepper is a cultivated perennial evergreen vine known botanically as the '*Piper Nigrum*.' Fig. 09 is representing the pepper plantation. It is the well-ripened tiny dry seed that is economically significant. It is native to the wet forests of India's western coastal hills, but it is now widely cultivated in both the Northern and Southern Hemispheres' tropics. The annual demand for Pepper is approximately 200,000 tons, accounting for roughly one-third of the world's spice trade volume. Indonesia, India, Vietnam, Malesia, and Brazil are the major pepper-producing and exporting countries. These countries account for 90 % of total exports [10]. The central pepper-growing districts in Sri Lanka are Mathale, Kandy, Kegalle, Badulla, Rathnapura, Kurunegala, and Nuwara Eliya. Pepper is currently grown on nearly 30,000 ha of land. Fig. 10 is representing the pepper cone. Pepper can be grown as a single crop with Live or inanimate Aids or a mixed yield with coconut and tea. *Piper Nigrum* is native to tropical regions forests on the Malabar coast of Southwestern India, including Kerala, Goa, and Karnataka. This spice is the dried unripe fruit of the trailing vine plant, the peppercorn, and it varies in colour, and it depends on when it is harvested. The most common is Black Pepper. To obtain black Pepper, select nearly ripe peppercorns and dry them until they turn black. In ancient Greece and Rome, the Black Pepper was a valuable commodity and became more popular during the Middle Ages and Renaissance. Vietnam now produces approximately 39 % of all black pepper production, Indonesia makes roughly 15 %, and India and Brazil each have around 10 % [11].



Fig. 09. Pepper Plant



Fig. 10. Pepper cones

More than just a flavour enhancer, black Pepper has health benefits thanks to its bioactive compounds, the most important of Piperine. Piperine is a natural alkaloid that contributes to the intense flavour of black Pepper. It is also the primary component responsible for black Pepper's health-promoting properties. Piperine is a type of antioxidant that aids in preventing chronic illnesses such as atherosclerosis, cardiovascular disease, and neurological conditions. This compound is also beneficial to nutrient bioavailability. When adding black Pepper to food, increase the number of nutrients that are absorbed into the bloodstream. Black Pepper stimulates the stomach's hydrochloric acid to digest and absorb the foods you eat. It also includes carminative properties, which help to reduce discomfort and gas build-up in the intestines.

4.5 Tea Plantation

Tea exports totalled 265.5 million kgs from January to December 2020 in Sri Lanka, decreasing 27.0 million kgs from the previous year's 292.6 million kgs. When exports are broken down by category, exports

of bulk tea, tea in packets, tea in bags, green tea, and instant tea had decreased in 2020. The tea production in Sri Lanka is divided into three groups. Tea grown above 1200m above mean sea level, primarily in the Badulla and Nuwara Eliya districts, is classified as "high-grown tea" or "upcountry tea." Fig. 11 and 12 representing the tea plant and tea plantation in Sri Lanka.



Fig. 11. Tea Plant



Fig. 12. Tea Plantation

Organic tea farmers and plantation workers are not exposed to toxic chemicals' adverse impacts because they do not need the administration of chemical fertilizers and pesticides. Moreover, numerous organic tea plantations in Sri Lanka are small and medium-sized. The cultivation of organic Ceylon tea enables them to compete and provide them with more economic capacity on global platforms. Benefits and fertilizers used for tea plantations tend to affect groundwater cycles and streams and rivers, as tea is often grown at higher elevations in Sri Lanka. They also represent the biodiversity of the environment. Pesticides are imbalances in an ecosystem by killing harmful insects and microbes and their natural predators such as spiders and marijuana and bacterial and fungal soil functions. Tea exports from Sri Lanka are, however, number one. That is why Sri Lankan tea on the world market is costly. So, the tea industry is the principal pillar of the foreign exchange of our country. Tea is an economically important crop that makes a substantial contribution to foreign trade and rural development. The tea industry also offers many other people jobs and a direct livelihood.

5 Research Methodology

The research project that we conducted was a data collection, and a face-to-face physical interview as a survey and a questionnaire was born in the palm grown areas. Three physical interviews were conducted for this purpose. We also observed many palm trees lands in Galle - landowners in the Imaduwa area, the Kottawa jungle area, and the grounds in the Horana area. The face-to-face questionnaire was the methodology for the success of this program, after finding out the landowners in those areas and discussing whether there is any good or bad in palm cultivation and whether they are aware of the solutions. Instead of palm cultivation, a program was launched to replace them with alternative plantations and make them economically viable. We selected five cultivations, coconut cultivation, tea cultivation, rubber cultivation, cinnamon cultivation, and pepper cultivation, suitable for palm cultivation, and those are subjected to favourable climatic and environmental conditions as alternative crops landowners to earn a steady income.

6 CONCLUSION

The article shows that the cultivation of oil palm produces a high range of environmental and social effects. The palm oil production process can continue to be more eco-friendly, sustainable. However, the

relationship between palm oil and groundwater depletion needs to be further analyzed. Instead of planting oil palm plantations, it is better to grow the sustainability of the environment from alternative crop suggestions to abundant and present harvesting palm plantations in Sri Lanka. More significantly, the study results can improve farmers' farming techniques and increase productivity for their landowners because the production and cultivation of the palm oil plantation itself have decreased. Good management of planting is also the key to success in increasing the productivity of farming. Managing oil palm plantations should consider several criteria that need to be considered: land selection, planting materials, technical management, harvesting, and environmental management and maintenance process. If those could be managed and integrated, all the categories in oil palm plantations, fresh fruit bunches, and much of them fit your desired output. The research process results can be interrupted by recognizing best crop management practices for a financially sustainable economy. Because of this, Sri Lankan export production will be poorly affected by this suggested essential crop farming than oil palm plantation. So, the five suggested alternatives are specifically export market achieved products.

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