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THE PALM OIL INDUSTRY AS A GLOBAL CLIMATE CHANGE SOLUTION

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RESUME

Global warming and global climate change have become a problem and concern for the global community. Due to the fact that this phenomenon has the potential to cause significant losses and even threaten the sustainability of life on Earth. Regarding the impacts and losses, the global community has agreed to make efforts to mitigate and overcome climate change. The global commitment to climate change mitigation is also contained in one of the 17 Sustainable Development Goals (SDGs) for the 2015-2030 period, namely Climate Action (SDG-13). This means that every person, company, industry, sector, country wherever and whenever needs to place themselves as part of the global climate change solution and mitigate its impacts. The palm oil industry is a part of the global industry, placing itself as a solution to the problem of global warming and global climate change through two simultaneous ways. The first way is to reduce the concentration of GHG in the earth's atmosphere through the mechanism of assimilation photosynthesis and phytosequestration of carbon. The characteristics of oil palm plantations have implications for their ability to absorb relatively large amounts of CO2 from the earth's atmosphere and store it in biomass. The second way is through the substitution of fossil energy with palm oil-based biofuels. GHG emissions can be reduced by 50-62 percent by substituting palm oil biodiesel for diesel fossil. Empirical evidence is that the implementation of the B30 program in Indonesia has succeeded in reducing carbon emissions by 22.3 million tons of CO2 eq.

INTRODUCTION

The issue of global climate change is one of the trending topics discussed by the global community for at least the last 20 years. Concentrations of greenhouse gases (GHG) in the earth's atmosphere have increased the intensity of the greenhouse effect from the earth's atmosphere (IEA, 2019). As a result, more of the sun's heat is trapped in the earth's atmosphere, thus pushing the increase in the earth's surface temperature, which is called global warming.

This global warming triggers the occurrence of irregular movements of the earth's air which is referred to as climate change (global climate change). Climate change in various forms, such as climate anomalies, extreme climates, floods, droughts, and others, has an impact on life on Earth now and in the future.

To prevent further damage to the planet's, joint efforts are needed on how to reduce GHG emissions into the earth's atmosphere and to reabsorb GHG that is already in the earth's atmosphere. Carbon dioxide (CO_2) is a component of GHG emissions that is primarily derived from the use of fossil fuels (IEA, 2019; Oliver et al., 2020). Therefore, efforts to reduce emissions and reabsorb CO_2 from the earth's atmosphere are important and strategic.

The global commitment to reduce the GHG effect on the earth's atmosphere has become one of the 17 Sustainable Development Goals (SDGs) for the 2015-2030 period, namely Climate Action (SDG-13). In this goal, every person, company, industry, sector, country wherever and whenever needs to put themselves as part of the global climate change solution and mitigate its impacts.

The palm oil industry is part of a global industry that places itself as part of the solution to the global problems above. The palm oil industry is a plantation crop with a cycle of 25 years, and its output is a biofuel raw material, making the palm oil industry very important in overcoming many problems (based on the previous paragraph).

This article will discuss the potential of the oil industry as part of the solution to climate change through the role of oil palm plantations as carbon sinks and phyto sequestration which reabsorbs CO_2 from the atmosphere of the earth. Then continue to discuss the role of palm oil as a biofuel feedstock that substitutes fossil energy to reduce CO_2 emissions.

PALM OIL AS A CARBON SINK

In the planet's ecosystems, the total terrestrial carbon stock is estimated to be around 3170 gigatons (Gt), consisting of 2500 Gt of carbon in soil, 560 Gt of carbon in plants, and about 110 Gt of microbial biomass. Meanwhile, the carbon stock in the oceans reaches 38000 Gt and the carbon pool in the earth's atmosphere is around 760 Gt (Jansson et al., 2010; The World Bank, 2012). The carbon cycle relates the dynamics of changes in carbon stocks in the earth's atmosphere, terrestrial and oceans.

The chain of sustainability of the global carbon cycle that is very important is the photosynthetic assimilation, namely the photosynthetic activities of plants that absorb carbon dioxide from the earth's atmosphere and store it as carbon stocks above and below ground biomass. Through that phytosequestration mechanism, the carbon stock then undergoes an advanced process into terrestrial carbon stock (territorial) and carbon stock in the waters/oceans (ocean).

One of the mechanisms through which oil palm plantations have played a role in solving climate change is through carbon sinks. Through the process of photosynthesis assimilation, oil palm plants absorb CO_2 from the atmosphere of the earth (Hardter etal., 1997; Henson, 1999; Fairhurst & Hardter, 2003). Oil palm trees are an annual plant (perennial plant) with a root system that is intensive, relatively large in size, rapid growth, and high production and cropping cycles for 25 years or more, thus making oil palm plantations "biological machines" to absorb CO_2 quite larger than the earth's atmosphere.

Based on studies by Henson (1999), the average amount of carbon sink of oil palm plantations (Table 1) on a net basis reached 64.5 tons of CO2 per hectare per year. Net absorption of CO_2 in oil palm plantations is

greater than in tropical forests. This is because tropical forests are generally in a steady state, where the rate of photosynthesis and the rate of respiration are in balance. On the other hand, the rate of photosynthesis in oil palm plantations is still much higher than the rate of respiration (Hardter *et al*., 1997; Fairhurst & Hardter, 2003).

Table 1. Carbon Sink in Oil Palm Plantations versus Tropical Forests

Indicator	Tropical Forest	Oil Palm
Gross assimilation (tonnes CO_2/ha/year)	163.5	161.0
Total respiration (tonnes CO_2/ha/year)	121.1	96.5
Net assimilation (tonnes CO_2/ha/year)	42.4	64.5
Oxygen production (tonnes O2/ha/year)	7.09	18.70
Leaf area index	7.3	5.6
Photosynthetic efficiency (%)	1.73	3.18
Radiation conversion efficiency (g/mj)	0.86	1.68
Total biomass in the area (tonnes/ha)	431	100
Incremental biomass (tonnes/ha/year)	5.8	8.3
Dry matter productivity (tonnes/ha/year)	25.7	36.5

Source: Henson (1999); PPKS (2004, 2005)

With the ability to act as a carbon sink, the total area of Indonesian oil palm plantations reaches 16.3 million hectares, which has the capacity to absorb 1035.3 million tons of CO_2 from the earth's atmosphere each year. This means that palm oil plantations reduce the concentration of CO_2 predicted for the earth's atmosphere, which has been exaggerated.

Carbon absorbed by oil palm plantations through the biosequestration mechanism is stored in the biomass, both above ground and in the underground root system (underground biomass). Chen (2002) calculated the amount of biomass and carbon stock (above ground biomass) resulting from sequestration in oil palm plantations (Figure 1).

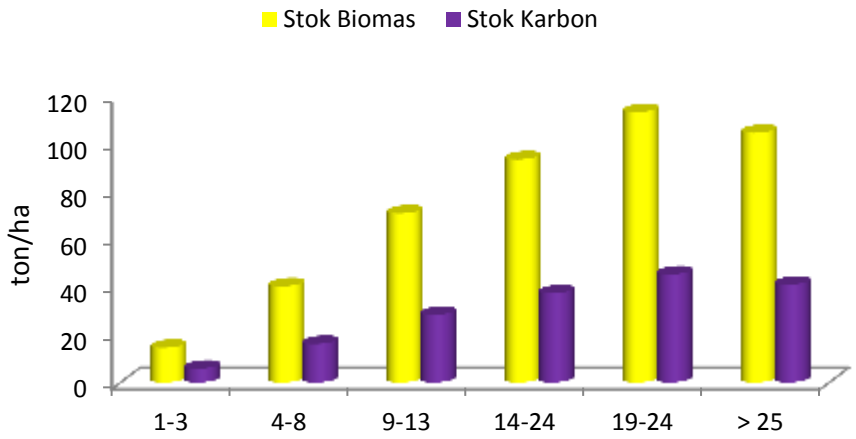

Figure 1. Carbon Sequestration, Biomass Stock and Carbon Stock in Above Ground Biomass in Oil Palm Plantations by Age (Source: Chan, 2002).

In general, carbon sequestration in oil palm plantations every year until they reach the age of 25 years has increased along with the increase in carbon sinks. This causes the stock of biomass and carbon stock in oil palm plantations to increase until the age of 25 years.

The volume of carbon sequestration in oil palm plantations varies depending on the age, density and fertility of oil palm plantations. Chen (2003) found variations in carbon stock ranging from 5.8 tons per ha (immature plant) to 45.3 tons per ha (at plant ages 20-24 years), or an average of 30 tons of carbon per hectare. While Kusumawati et al. (2021) found that one-year-old oil palm plantations contained a carbon stock of 43.5 tonnes per hectare and that 28-year-old oil palm plantations had a carbon stock of 74.7 tonnes per hectare.

Meanwhile, the Khasanah study (2019) revealed that the average carbon stock in above-ground biomass in oil palm plantations in Indonesia reached 40 tons per hectare. With an area of 16.3 million hectares of Indonesian palm oil plantations, the total carbon stock reaches 652 million tons of carbon. This means that at least 652 million tons of CO_2 from the earth's atmosphere have been absorbed and stored in above-ground biomass from Indonesian palm plantations (not including below-ground biomass).

It is thus very clear that oil palm plantations play an important role in reducing the concentration of CO_2 in the earth's atmosphere through photosynthesis and the process of phytosequestration disclosed in biomass. The reduction of CO_2 concentration in the earth's atmosphere is clearly a part of the solution to reduce global warming and climate change.

FOSSIL ENERGY SUBSTITUTION

The second way regarding the contribution of the palm oil industry as part of the global warming and climate change solution is through its products as a substitute for fossil energy. As it is known, the largest global source of GHG emissions is fossil fuel. Therefore, one way to reduce GHG emissions is to reduce the consumption of fossil energy and switch to lower emmision energy.

Like other biofuel crops, palm oil is a feedstock biodiesel that can replace fossil diesel and save 50-62 percent of emissions (European Commission, 2012). Internationally, the use of palm oil as a raw material for biodiesel has also increased from year to year.

In Indonesia's experience, the substitution of fossil diesel with palm biodiesel through the implementation of mandatory biodiesel policies can save GHG emissions from diesel engines (Figure 2).

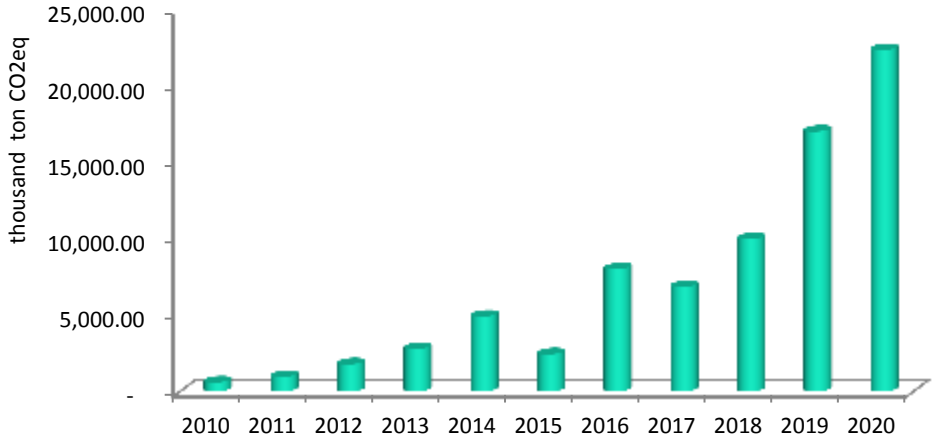

Figure 2. Reduction of GHG Emissions due to the Mandatory Biodiesel Program in Indonesia.

Along with the increase in substitution of fossil diesel with palm oil-based biodiesel, the reduction of GHG emissions in Indonesia's energy and transportation sectors has also increased. In 2018, the reduction in GHG emissions due to the substitution of fossil diesel with biodiesel (B20) reached 10.6 million tons of CO_2 equivalent, or approximately 27% of the national energy and transportation sector emission reduction target.

The realization of the B30 program in 2020 also has implications for reducing emissions in the energy and transportation sectors. The 8.4 million kiloliter volume of fossil diesel replaced by biodiesel (B30) has an impact on reducing GHG emissions to reach 22.3 million tons of CO_2 eq, or about 59 percent of the energy and transportation sector's emission reduction targets. This shows that the reduction in GHG emissions is getting bigger along with the increasing volume of fossil diesel which is replaced by palm oil-based biodiesel.

Opportunities for reducing GHG emissions in the energy and transportation sectors in Indonesia will also be widely open in the future through the development of new palm oil-based biofuels, namely green diesel, green gasoline and green avtur. The presence of green diesel combined with biodiesel is expected to replace fossil diesel. Meanwhile, the high consumption of premium fossil fuels and still growing every year and can be substituted by green gasoline. Likewise, green avtur can replace fossil fuel avtur consumption.

Using palm oil as a raw material (feedstock) for biofuel has been carried out in various countries. Palm oil accounts for approximately 30 percent of the global feefstock biodiesel because it is less expensive and the supply of raw marerial is guaranteed and stable. use palm oil because it is cheaper and the supply of raw material volume is guaranteed and stable. By mixing palm oil biofuels with fossil fuels, GHG emissions from the world's fossil energy will be reduced internationally. This will contribute to solutions to the problems of global warming and global climate change.

CONCLUSION

The palm oil industry can present a solution to the problem of global warming and global climate change in two ways simultaneously. The first way is to reduce the concentration of GHG in the earth's atmosphere through the mechanism of assimilation photosynthesis and phytosequestration of carbon by oil palm plantations. Oil palm plantations are perennial plants with a life cycle of 25 years or more, and their relatively large size, with growth relatively quickly and production relatively large, means that they have the ability to absorb CO_2 from the atmosphere in relatively large quantities and store it in biomass both above and below ground.

The second way oil palm plantations contribute to mitigating global warming and climate change is by reducing GHG emissions into the earth's atmosphere through the substitution of fossil energy with palm oil-based biofuels. With the large availability of palm oil, which is relatively cheap and in stable supply, it is possible to produce palm biofuel internationally to replace some of the fossil fuel. By substituting palm oil biofuels such as biodiesel for fossil energy, GHG emissions can be reduced by 50-62 percent.

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