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THE CONSEQUENCES OF GROWING OIL PALM IN INDONESIA[1]

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ABSTRAK

Kelapa sawit, sebagai sumber bahan bakar nabati selain jagung dan kedelai, merupakan salah satu komoditas pertanian penting didunia. Saat ini, perkebunan kelapa sawit di Asia Tenggara, khususnya di Indonesia telah memproduksi sekitar 84% diesel nabati dari yang dibutuhkan dunia. Indonesia termasuk penghasil kelapa sawit terbesar didunia, dengan areal perkebunan seluas 7.1 juta hektar yang didalamnya termasuk sistim pertanian rakyat yaitu sekitar 35%. Seiring dengan meningkatnya permintaan dunia, maka Indonesia memerlukan lahan untuk perluasan perkebunan kelapa sawit. Fakta ini menimbulkan berbagai dampak baik dari segi lingkungan, kondisi sosial maupun ekonomi masyarakat. Secara umum, Indonesia sedang berada dipersimpangan jalan untuk menentukan arah "pengembangan kelapa sawit" di masa datang, terutama dalam menentukan pilihan kegunaan lahan, yaitu lahan bagi produksi bioenergi, pelestarian hutan atau penciptaan sumber pangan. Berawal dari kenyataan tersebut, maka diperlukan informasi terkini tentang status "pengembangan kelapa sawit" dalam kaitannya dengan pemenuhan keperluan dasar masyarakat (pangan dan bahan bakar) dan kepentingan lingkungan (pelestarian hutan dan keanekaragaman hayati serta pengurangan emisi CO_2). Makalah ini memberikan gambaran tentang berbagai peluang dan tantangan mengenai "pengembangan kelapa sawit" baik ditinjau dari skala nasional maupun global.

Kata kunci: biodiversity, biofuels, carbon sequestration, Indonesia, oil palm

ABSTRACT

Oil palm is rapidly becoming one of the world's major sources of biofuels in addition to corn and soybeans. Oil palm plantation currently accounts for 84% of biodiesel production and much of the world's palm oil is produced from the forests of SE Asia, especially Indonesia. Indonesia is the world's leading palm oil producer and has planted palm estates of 7.1 million hectares, with smallholders accounting for about 35%. Continued growth of the world demand for biofuels has caused expansion for oil palm plantation, which creates the most devastating costs in the environment, society, and economy. Today, Indonesia is facing uncertainty for the future of oil palm movement to choose among biofuels, forest, and food. Information is provided to see if oil palm movement creates new threats to the human needs (i.e., food and fuel) and environment (i.e., forest, carbon dioxide emission and biodiversity). Global and national views regarding opportunities and challenges in oil palm movement are addressed.

Keywords : biodiversity, biofuels, carbon sequestration, Indonesia, oil palm

INTRODUCTION

Background

The world's demand for oil palm has soared in the last two decades. Its first use was for food and household products, and more recently, as the raw material for biofuel. This increases pressure on land in Indonesia because Malaysia and Indonesia account for about 87% of world production (USDA, 2007). As Indonesia surpassed Malaysia in palm oil production in 2007, Indonesia's government established policies to expand land for new plantations (Jakarta Post, 2008).

As the largest palm oil producer in the world, Indonesia produced about 18 million tons of palm oil in 2008 with recorded exports of US $5.5 billion and more than 75% of its palm oil production in the form of CPO. Indonesia exports palm oil to more than 150 countries, including India, China, Pakistan, and Japan as well as European and Middle Eastern countries (Jakarta Post, 2008). Toward 2011, Indonesia plans to expand on 4.8 million hectares for palm oil plantations. This designation is to increase oil palm production rate as well as to fulfill the world demand for biofuels in the foreseeable future (USDA, 2007). Recently, the land available for new plantations can only be found in Papua, Sumatra, and Kalimantan. Papua has about three to

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four million hectares, and Sumatra and Kalimantan provide the rest. Unfortunately, 80% of the available land in Papua is under the forest and some areas in Kalimantan are peat swamps or organic soils (Radio New Zealand International, 2008). Approximately 27% of the concessions for new palm oil plantations are on peat land rainforest, covering 2.8 million ha (Fargione et al., 2008). Meanwhile, abandoned land, idle land, or unproductive grassland is not considered as the target land for new oil palm plantation. This creates new threats and more pressure to the community land, which is originally for food production. In addition, land conversion, especially from forest to oil palm plantations, emits carbon dioxide into the atmosphere as well as decreases the biodiversity.

Aims of the Study

In this paper, we discuss how the prospects of oil palm production will put Indonesia on the spot between growing "food or biofuel" for sustainability as well as in terms of carbon sequestration and biodiversity. These three aspects are the most important consequences of oil palm movement in general (Germer and Sauerborn, 2008; Shiva, 2007; Fitzherbert et al., 2008).

FOOD VERSUS BIOFUELS

The global emergence of interest in bio-based products has resulted from the timely coalescence of economic considerations, environmental concerns, and scientific advancements (Young, 2003). Recently, there is a concern to develop new energy sources to curb climate change by taking advantages of plants (Young, 2003). With the growing population and food demand in the future, there will be challenges of increasing agricultural productivity either for the food or fuels demand or both (Young, 2004).

Recent policies on renewable energy have promoted a rapidly growing biofuels industry, which resulted in the depletion of surplus agricultural feedstocks in Europe and the United States, contributing to commodity price increases of bioenergy crops such as corn and soybean (Johnson, 2008). Furthermore, Kloverpris et al. (2008) reported that the increased production of the first generation of biofuels, such as biodiesel and bioethanol, lead to more demand for crops that can only be fulfilled by land expansion or the intensification of existing crop production. This condition brings the debate about food versus biofuels.

According to Chakrabortty (2008) some reporters described that biofuels caused food crisis, by revealing that: "*Biofuels have forced global food prices up by 75%-for more than previously estimated-according to World Bank Report.*" On the other hand, the Agricultural Outlook 2007-2016 Report noted: "*Temporary factors such as droughts ... and low stocks explain in large measure the recent hikes in farm commodity prices ... Reduced crop surpluses and a decline in export subsidies are also contributing to these long-term changes in markets. But more important is the growing use of cereals, sugar, oilseed and vegetable oils to produce the fossil fuel substitutes, ethanol and biodiesel ... And while higher feedstock prices caused by increased biofuels production benefits feedstock producers, it means extra costs and lower incomes for farmers who need the feedstock to provide animal feed.*" (OECD-FAO, 2007).

The increase of population also creates competition in land for food or biofuels production. It is estimated that 40% of the world's agricultural land is seriously degraded (Santa Barbara, 2007) and in Indonesia, more than two million hectares are considered a degraded land (Handayani, 2004). The magnitude and location of land use changes caused by biofuels production depend on where the demand arises (Kloverpris et al., 2008). The double demand estimated by 2030 requires Indonesia to double its production within eight years. Consequently, palm oil demand has made Indonesia's government put more focus on land expansion for new plantations (Jakarta Post, 2008).

Based on the calculation from Indonesian Biodiesel Forum (IBF), in 2009, biodiesel from oil palm is projected to reach 2% of diesel consumption or 0.7 million kL, requiring over 200,000 ha of oil palm plantations (www.tempointeractive.com). From 15-20 tons of fresh fruit bunches of oil palm per ha produce 0.2-0.22 m^3 of raw oil, with 0.95 L of biodiesel produced from one L CPO. This means 0.3 ha of oil palm plantation would be required to generate 1,000 L (1 kL) of biodiesel (Soerawidjaja, 2005). With more demand expected in 2025, Indonesia will need about 1.41 million ha of oil palm plantation when the demand for biodiesel is projected to reach 5% of petroleum diesel consumption, which is equivalent to 4.7 million kL (www.tempointeractive.com).

Increasing available land for new oil palm plantations causes impact on indigenous people surrounding the plantation. Some reports show that indigenous people are suffering the negative impacts of oil palm plantations because cultivating oil palm does not allow farmers to do traditional intercropping, as does rubber (www.tempointeractive.com). Indigenous people also reported that living costs are higher after palm oil plantations are established and they cannot plant rice or other crops and or tap rubber.

Currently, about six million ha of land in oil palm plantations can supply the domestic and international market for household products such as soap, toothpaste, margarine, and cooking oil. If the requirements of biodiesel are added on top of this, it is likely that there will not be any forests left in Indonesia in a few years' time outside national parks and other protected areas, leaving insufficient cropland for food production. In addition, the local communities whose lives depend on forests and cropland will be destroyed because their land will be planted with oil palm-monoculture to supply the renewable energy industry (DTE, 2006).

In this case, Indonesia has to be careful while growing and producing palm oil in order to avoid unintended consequences even though biofuels is important to reduce our dependence on petroleum. Technology to improve the potential generation of biofuels that reduces carbon dioxide emission has to be initiated. Also, new opportunities have to be given to rural development by providing crop land and energy required to produce food. The question now is: which is more important for humankind – to sustain life by growing food or biofuels? (DTE, 2006).

OIL PALM PLANTATION FOR CARBON SEQUESTRATION

Industrial biofuels are being promoted as a source of renewable energy and can reduce greenhouse gas emissions via carbon sequestration in the plant biomass and soil. However, there are reasons why converting palm oil into liquid fuels can actually aggravate climate chaos and the carbon dioxide burden on earth (Shiva, 2007). Deforestation for establishing oil palm plantation is leading to increased carbon dioxide emissions. The United Nations Food and Agriculture Organization estimates that 1.6 billion tons or 25 to 30% of the greenhouse gases released into the atmosphere each year comes from deforestation. By 2022, biofuel plantations could destroy 98% of Indonesia's rainforests (Shiva, 2007). Destruction of peat land in SE Asia for oil palm plantation contributes 8% of the global carbon dioxide emissions. Each ton of palm oil results in 30 tons of carbon dioxide emissions or 10 times as much as petroleum producers. Thus, industrial biofuels seem to contribute to the same global warming that they are supposed to reduce (World Rainforest Bulletin, 2006). In fact, the conversion of biomass to liquid fuel utilizes more fossil fuels than it substitutes (Shiva, 2007).

However, not all oil palm plantations emit more carbon dioxide to the atmosphere. Establishing new oil palm plantations from forest creates more carbon dioxide emissions compared to grassland of *Imperata cylindrica* (Germen and Sauerborn, 2008). In Indonesia, Thailand, and Papua New Guinea planting cacao, rubber, and oil palm has expanded. Worldwide, the area under cacao cultivation has expanded by 61% and rubber area by 60% within the last three decades (FAOSTAT data, 2005). Thus, oil palm will not replace rubber or cacao, but may lead into other areas such as natural forest land or idle grassland. Therefore, most of the oil palm plantations is likely to expand either on forest land or rehabilitated grassland (Germer and Sauerborn, 2008).

Oil palm plantation establishment requires the removal of plant cover of the existing forest or grassland. After clearing, the biomass can be burned or naturally decomposed (MacKinnon et al., 1996). Decomposition releases plant nutrients that become available again to plants and emits the carbon contained in the biomass into the atmosphere as carbon dioxide (CO_2). According to Germer and Sauerborn (2008), the complete decay of 1 ton cut biomass results in an emission of 1.8 tons CO_2. This translates into a total emission from biomass decomposition of 42 tons CO_2 per ha of grassland and 627 tons CO_2 per ha of forest (Table 1). This indicates less CO_2 emission was observed under oil palm plantation established from previously grassland than forest land.

Burning of the cleared vegetation is a common practice in the conversion of forest into arable land to reduce the bulky biomass and facilitate subsequent fieldwork (Fearnside, 2000). However, the biomass of grassland is relatively low and burning is not necessary to assist in oil palm planting. Burning is also known to significantly decrease soil carbon by emitting carbon dioxide into the atmosphere, and may increase the weed population (King and Grace, 2000). In the case of using grassland for new oil palm plantation, the total emission from above-ground biomass burning and the decay of unburned above- and below-ground biomass is 43.5 tons CO_2 per ha. Combustion plus decomposition of forest biomass would otherwise release 648 tons ash burning and the decay of unburned above- and below-ground biomass is 43.5 tons CO_2 from each ha (Table 2). These data support the results from Table 1 showing that oil palm plantation established from grassland provides less CO_2 emission than from forest land.

The amount of carbon fixed in oil palm plantation biomass is primarily a function of palm growth and the understory. Published values of oil palm above-ground biomass range from 50 to > 100 tons per ha towards the end of the plantation's economical live span after 25 years (Germer and Sauerborn, 2008). The total time-averaged above and below-ground biomass in an oil palm plantation is 82.5 tons per ha. Assuming a carbon content of 40.4% for oil palm biomass (Syahrinudin, 2005) and of 50% for the remaining vegetation (IPCC, 1997), both palms and understory can fix 35.3 tons of carbon per ha within the economic life span of oil palm (Germer and Sauerborn, 2008).

Establishment of oil palm plantations releases emission

Table 1. Carbon dioxide emissions (ton ha^{-1}) as a result of complete decomposition of above and belowground biomass of forest or grassland vegetation after converting the land into oil palm plantation. *Source: Germer and Sauerborn (2008).*

Previous land use	Total biomass	Carbon content	CO_2 emissions
Forest	342 (178)§	171(89)	627(326)
Grassland	27 (17)	11 (7)	42 (27)

§ values inside the parentheses indicate standard deviation

Table 2. Carbon dioxide equivalent (ton ha^{-1}) caused by burning and decomposition of above-ground biomass (AGB) of forest or grassland vegetation during the first 25-year oil palm rotation. *Source: Germer and Sauerborn (2008).*

Land use	CO_2 from AGB burned	CO_2 from decom-position	Total CO_2
Forest	237 (122) §	411 (215)	648 (337)
Grassland	16 (11)	27 (18)	43 (28)

§ values inside the parentheses indicate standard deviation

Table 3 Greenhouse gas balance in carbon dioxide equivalents (ton ha^{-1}) for oil palm plantation establishment on degraded grassland and on forest on mineral and organic soil. *Source: Germer and Sauerborn (2008).*

Activity	Land clearing	Change in soil C or peat decom-position	Fixation in oil palm plantation biomass	Balance
Grassland rehabilitation (zero burning)	42 (27)	-48 (24)	-129 (40)	-136 (37)
Grassland Rehabilitation (burning)	43 (28)	-48 (24)	- 129 (40)	- 134 (36)
Forest conversion (zero burning) on mineral soil	627 (326)	150 (75)	- 129 (40)	647 (361)
Forest conversion (burning) on mineral soil	648 (337)	150 (75)	- 129 (40)	668 (372)
Forest conversion (zero burning) on peat	627 (326)	816 (393)	- 129 (40)	1314 (679)
Forest Conversion (burning) on peat	648 (337)	816 (393)	- 129 (40)	1335 (690)

of GHGs due to biomass burning and decomposition as well as loss of carbon and decomposition. However during the growth, plant biomass and accumulation of soil organic matter act as a sink for atmospheric carbon (Germer and Sauerborn, 2008). Table 3 shows the balance of the GHGs fluxes in CO_2 from the principal sources and sinks initiated by conversion of grassland and forest into oil palm plantations. The conversion of forest into oil palm plantations causes emission in a range of less than 650 to over 1300 tons per ha within a 25-year time frame. Decomposition of organic matter in peat soil usually exceeds GHG emissions derived from forest biomass. Establishment of oil palm plantations on grassland result in an increase in biomass and soil carbon (Germer and Sauerborn, 2008). These carbon sinks not only neutralize emissions caused by land conversion, but drive a net CO_2 sequestration of 135 tons per ha (Table 3). Oil palm establishment following grassland rehabilitation provides more carbon sequestration and less CO_2 emissions compared to forest clearance. However, there is still a need for a detailed cost benefit analysis of oil palm plantation establishment over grassland.

IMPACT OF OIL PALM EXPANSION ON BIODIVERSITY

The ecological impact of oil palm depends on the extent to which its expansion causes deforestation, and on the extent to which it is able to support biodiversity (Fitzherbert et al., 2008). Oil palm expansion contributes to deforestation in four ways: (1) as the primary motive for forest clearance; (ii) by replacing forests previously degraded by logging or fire; (iii) as part of a combined economic enterprise; or (iv) by establishing improved road access to previously inaccessible forest or displacing other crops into forests (FAO, 2006).

In Indonesia, commercial oil palm cultivation started in Sumatra in 1911 and expansion to other parts did not occur until the 1980s (Corley and Tinker, 2003). Between 1990 and 2005, the area of oil palm increased from 4.4 million ha to 6.1 million ha while total forest loss was 28.1 million ha (FAO, 2006). Therefore, conversion to oil palm could account for at most 16% of recent deforestation. It has been estimated that 1.7 to 3.0 million ha of forest were lost due to oil palm plantation over this period (Koh and Wilcove, 2008).

Publications on the effect of oil palm plantation establishment make up less than 1% of the scientific literature since 1970 (Turner, 2008). We will provide previous literatures comparing biodiversity in oil palm plantations and other land uses. For example, rubber plantations (*Hevea brasiliensis*) supported more species than oil palm plantations, but cocoa plantations (*Theobroma cacao*) had similar (Glor et al., 2001) or higher (Room, 1975) species richness. Acacia plantations (*Acacia mangium*) had higher beetle species richness than oil palm plantations, but the species composition in oil palm plantations was closer to forest (Glor et al., 2001; Room, 1975). *Imperata cylindrica* grasslands which cover at least 8.5 million ha in Indonesia had more species of ants than oil palm plantations, but fewer than in the forest (Room, 1975).

Following plantation establishment, the greatest environmental impacts are also from pollution. Water pollution from plantations and onsite mills is likely to affect aquatic biodiversity (Dudgeon, 2006), but such impacts have not been addressed in relation to oil palm production. Potential pollutants include palm oil mill effluent (POME), fertilizers, and pesticides (Corley and Tinker, 2003). Even though efforts to reduce the impacts of some of these pollutants are in place in some plantations, we still need "biodiversity-friendly management practices" to be more available in the field (Fitzherbert et al., 2008).

CONCLUSIONS

Biofuels, fuels from biomass, are always going to be the most important energy source for the poor, unlike the industrial biofuels (biodiesel and ethanol). Some lands for industrial biofuels may be needed for food for the poor (Shiva, 2007). Carbon sequestration calculation shows that there is more advantage of oil palm establishment over grassland rehabilitation compared to forest clearance. Therefore, with global emission trading becoming a reality, emitters unable to meet their own targets could pay off through carbon sequestration in oil palm plantations. Currently, the price for carbon dioxide emission credits traded on the European market is above 27 Euro per metric ton (PointCarbon, 2006). At this price the rehabilitation of grassland through establishment of oil palm plantations would value above 4.000 Euro per ha (Germer and Sauerborn, 2008). For biodiversity, oil palm plantations are a poor substitute for native tropical forests and therefore any conversion of natural forest is destroying the biodiversity. Oil palm plantations support even fewer species than do most other agricultural land uses (Fitzherbert et al., 2008). In summary, the consequences of growing oil palm in Indonesia to fill the world demand on biofuels provide opportunities to improve the value of protecting the human needs (i.e., food and fuel), as well as the environment (i.e., forest, carbon dioxide emission and biodiversity). Governments, environmental and social organizations, scientists, producers, financial institutions, and buyers have the capacity to soften the impacts of intensive oil palm production. Although the best strategy for the mitigation impact of growing oil palm differs within and between islands, there are still several emerging solutions allowing rural and urban development to be friendly to local communities.

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