The social and economic impacts of peat Land palm oil plantation in Indonesia

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Abstract. The area of peatland in Indonesia reaches 13 million hectares, around 12.37%, 1.67 million hectares, used for plantations. Around 700 to 800 thousand ha are used for oil palm plantations, with a productivity of 20-25 tons / ha / year, this value is no less than that of other types of land. The purpose of this study was to analyze the social and economic impacts of oil palm plantation development, analyze the financial feasibility of cultivation on peat and non-peat lands and analyze the sustainable management model of oil palm plantations. The results of this study, the development of oil palm plantations has a positive impact on economic and social conditions. Social problems arose between the company and the community in the management of oil palm plantations when the government issued a moratorium on permits for the opening of oil palm plantations on peatland due to fire. The exploitation of oil palm on peatlands has lower benefits compared to mineral land. Management of oil palm plantations can be carried out on peatlands, but it is necessary to consider water regulation so that oil palm plantations are sustainable on peatland because peatlands are easily damaged land.

Keywords: Sustainable oil palm plantation development, palm moratorium, financial feasibility, water regulation, peat soil management.

1. Introduction

The area of oil palm in Indonesia from 2013 to 2017 has increased, from 10.46 million hectares to 14.03 million hectares, an increase of 34.07 percent. The highest increase came from an increase in large plantation area of 37.79 percent, from 6 million hectares to 8.4 million hectares. Meanwhile, the people's plantation area increased from 4.35 million hectares to 5.62 million hectares, an increase of 28.86 percent. Peatlands are one of the potential lands for oil palm plants. The area of peatland in Indonesia reaches 13 million hectares, around 12.37%, 1.67 hectares is used for plantations (BBPSDLP 2017). According to Winarna in 2012 only 700-800 thousand ha of peatland was used for oil palm cultivation from the total area of oil palm plantations in Indonesia 7.8 million Ha. Palm oil production on peatlands can reach 20-25 tons/ha/year, productivity on peatland is no less compared to productivity in other types of soil [1].

Table 1. The Indications of the Use of Peatlands in Indonesia [2]

No	Land Closure	Large (ha)	Percentage
1	Forested Area	6.387.941	47,5
2	Plantation	1.672.295	12,37
3	HTI	569.832	4,04

No	Land Closure	Large (ha)	Percentage
4	Agricultural land	657.149	4,85
5	Rice Fields	199.434	1,48
6	Shrubs	2.722.214	20,26
7	Mining	8.763	0,07
8	Settlement	27.840	0,21
9	Other	1.252.906	9,21
	Total of peatland in Indonesia	**13.498.374**	**100**

The highest utilization of peatlands in Indonesia is for shrubs, around 2.72 hectares or around 20.26 percent. According to Noor, M., 2007, the improper land management with land clearing activities that lack attention to environmental biophysical characteristics, can cause peatland experience degradation and become abandoned land. This condition causes loss of genetic resource diversity, socio-cultural disintegration and marginalization of farmers and environmental damage [3]. Peatland conversion can increase the oxidation rate so that it is susceptible to fire, subsidence, flooding and seawater intrusion. The Disruption of the function of peat swamps can also cause the release of carbon into the atmosphere and encourage the rate of climate change [4], [5]. The peatland areas will be difficult to recover if they have been damaged [6]. This stage will certainly have a negative impact on the surrounding the community. The efforts of the Ministry of Environment and Forestry (KLHK) to overcome these environmental problems is by not issuing new permits for the management of peatlands, both those who have licensed and those who have not, especially those relating to palm oil development.

Actually, in the management of sustainable palm oil, RSPO allows oil palm plantations on peatlands, but what needs to be considered is in draining peatlands, if it is not done with adequate technology and the authority available to monitor and maintain groundwater levels from time to time then it will endanger the environment. Therefore, this study focuses more on optimizing the peatland resources for oil palm plantations in Indonesia.

The purpose of this study is:

1. Analyze the social and economic impacts of the development of oil palm plantations
2. Analyzing the comparison of financial feasibility between cultivation on peat and non-peat land
3. Analyze the sustainable management model of oil palm plantations.

The national workshop on sustainable peatland utilization in Bogor on October 28, 2010 formulated that peatland as an area covered with sediments of organic material with a thickness of >50 cm, most of which had not been fully weathered and buried for a long time and had C-organic content >18% [6]. Peat soil recruits soil taxonomy grouped into the hitosol order because it has different characteristics and properties to the soil type of mineral soil generally (Noor 2001). According to the Minister of Agriculture Regulation (PERMENTAN) Number 14/Permentan/PL.110/2/2009 in 2009, the criteria for peat land for oil palm plantations are located in the cultivation area, can come from forest areas that have been released and/or other areas of use (APL) for oil palm cultivation business and has a thickness of peat layer less than 3 (three) meters. The peat area that can be used is mature peat (*saprik*) and half-peat (*hemic*), while raw peat is prohibited for the development of oil palm cultivation.

According to Suwardi in 2017, suboptimal soils such as peat soil and acid sulphate soils in Indonesia are still available for planting oil palm. These lands are actually difficult to be planted with other agricultural crops, but there are plants that can grow well, namely oil palm and acacia .

Oil palm cultivation on peatlands needs to involve water management, soil compaction, and fertilization, and if these three factors are not managed properly, the sustainability of peatlands will be threatened. If the management of the water system is bad, it will have a significant effect on the decline in production. In addition, if the water level is too low, this will increase the subsidence rate and the risk of peat fire accidents. The drainage also has an effect on increasing production yield, if

drainage is bad, it can cause irreversible dry conditions. Therefore the water management is an initial requirement for successful management of peatlands.

2. Analysis Method

The analysis will be carried out using the desk study method using secondary data related to oil palm and peat in Indonesia as well as a number of regulations regarding palms. In addition, in financial analysis, benchmarking was carried out from previous studies using the feasibility analysis method, namely the analysis method using Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP) and BC Ratio.

Feasibility analysis

In analyzing the feasibility of an investment, this can be seen from several aspects, such as economic aspects, technical aspects, marketing aspects, and financial aspects. This study focuses more on the feasibility of financial aspects. Some investment feasibility indicators can be seen from: (1) Net Present Value (NPV), (2) Internal Rate of Return (IRR), (3) Payback Period (PBP) and (4) Benefit Cost Ratio.

Net Present Value (NPV)

Net Present Value (NPV) carried out to analyze the value of investment by considering changes in currency values. The Net Present Value of a project is the present value between benefits compared to costs.

Mathematically NPV can be written as follows:

$$NPV = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+i)^t}$$

Where :

B_t = Total acceptance of year t
n = Economic age
C_t = Total cost of year t
i = interest rate

Furthermore, the criteria used for this NPV value are:
NPV> 0, business is worthy to run
NPV = 0, the business returns the same amount of money invested
NPV <0, business is not feasible to run by:

Internal Rate of Return (IRR)

The IRR value of an investment is the prevailing interest rate (discount rate) which shows the present value (NPV) equal to the total amount of the project investment. Here's how to calculate the IRR, namely:

$$\sum_{t=0}^{n} \frac{B_t}{(1+i)^n} = \sum_{t=0}^{n} \frac{C_t}{(1+i)^n}$$

Where:

i = Discount rate used
B_t = Total acceptance of year t
t = Number of years of analysis
C_t = Total cost of year t
n = The last period of expected cash flow

Payback Period (PBP)

Is a period or minimum time needed to be able to return the investment that has been issued through the profits obtained from a project. Mathematically Payback Period is as follows:

$$Payback\ Period(PBP) = \frac{net\ investment}{average\ annual\ operating\ cashflow}$$

PBP value is said to be feasible if the PBP value is smaller or equal when compared to the age of business investment.

Furthermore, for the BCR analysis method, which is a comparison between total revenue and total costs which shows the value of the value of revenue obtained from each rupiah that has been spent. An activity or project is said to be feasible if it has a BCR greater or equal to (≥) 1.

$$BCR = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1 + IRR)^2}$$

Where:

B_t = Total profit for year t
n = Economic age
C_t = Total cost of year t

Social and Economic Impacts of Oil Palm Plantation Development

The Peatlands play an important role in environmental protection and climate change, besides that, peatland is a resource that can be used for productive land, such as for agriculture/plantations.

Some environmental issues in the development of peatlands include:

1.Deforestation / Degradation of peat swamp forests

During 2016 to 2017, the extent of deforestation for the opening of plantation areas and HTI in approximately 479 thousand ha consisting of forest areas covering an area of 308 thousand ha and in other use areas (APL) covering 171 thousand ha. Based on data from KLHK (2018), extensive deforestation is found in Kalimantan (229.8 thousand ha) and Sumatra (127 thousand ha).

2. Subsidies and peat fires

If the drainage from the channels in the peatlands is not controlled properly, then this can lead to subsidence because peat has irreversible drying properties or it means that once there is excessive dryness the peat colloidal nature will be damaged so that the peat cannot hold water. According to Chotimah (2002), the peat will lose the water available after experiencing drought for 4-5 weeks. In addition to not being able to hold water, the peat which has already dried up can no longer absorb nutrients. As a result, peat changes its charcoal-like properties so that in the dry season it is very prone to fire. In addition to fires, because peat has a very low bulk density, it will cause subsidence.

3.Carbon emissions

The conversion of peatland to other uses, such as for plantations, results in carbon loss. Under disturbed conditions, carbon in peatlands can be reduced and increase the concentration of carbon in the atmosphere. There are 2 causes of carbon loss that occur most often, namely (1) conversion of forest land and (2) fire, which is a biomass fire on peatland. Peatland fires are more dangerous than fires on dry land (mineral soils). In addition to surface vegetation fires, the peat layer also burns and lasts long, resulting in thick smoke due to incomplete combustion. The government issued Presidential Instruction No. 10/2011 to address environmental problems related to the negative impacts of peatland use, such as fire and deforestation. Through this Presidential Instruction, the government ensures that it will temporarily suspend or memorize the issuance of permits to convert natural forest land into oil palm plantations.

Subsequently in 2015, when a fire and smoke disaster struck Indonesia, President Joko Widodo wanted to continue the moratorium on oil palm plantations. The minister of Environment and Forestry (LHK) Siti Nurbaya on November 3, 2015 issued a letter concerning the prohibition on the opening of peatland to holders of IUPHHK-HTI/HA/RE and plantation business permits. The letter numbered S.494/MENLHK-PHPL/2015 refers to a cabinet meeting on 23 October 2015 stating that the development of forestry and plantation businesses is not by clearing land in peatland areas.

The government issued a moratorium rule, due to several things, as summarized by Sawit Watch, 2017, namely: (1) Productivity of Indonesian oil palm plantations is still low. Indonesian palm oil productivity is only around 2-3 tons per hectare per year, while Malaysia's productivity achievement reaches 4.11 to 4.50 tons per hectare per year. Whereas in the research scale, the potential of palm oil production can reach up to 7-8 tons per hectare per year; (2) One factor that perpetuates forest and land fires. The forest and land fires that occurred in 2015 are one of the largest forests and land fires that have occurred in Indonesia with the number of hotspots in Sumatra and Kalimantan being the dominant locations of forest and land fires reaching more than 20,000 parts of the large in the oil palm plantation area. According to the World Bank, losses from fires in 2015 reached USD 16.1 billion (221 trillion); (3) Agrarian conflict continues to increase along with the expansion of large oil palm plantations. In 2015, the agrarian conflict in the 2015 plantation sector reached 127 cases with an area of 302,513 hectares. Furthermore in 2016 there were more than 782 conflicts between communities and oil palm plantation companies; (4) Realization of the development of oil palm plantations that are not suitable from the planning, even found plantation without permits. (5) The occurrence of modern slavery practices in oil palm plantations, where the number of workers working directly on oil palm plantations reaches 10.4 million people, around 70 percent of whom are status as casual daily laborers, outsourced workers, contract laborers, seasonal workers or workers who do not have guaranteed job security and are not accommodated by health and social security; and (6) Policy inconsistency in the peat ecosystem. The need for decisiveness from the government to harmonize important and urgent policies and regulations is carried out if Presidential Instruction No. 8 of 2015 concerning Delay of New Permits in Natural Forests and Peatlands is not extended. The Peat Ecosystem is an open area for the development of oil palm plantations. Based on Government Regulation No. 57 of 2016, the groundwater level on peatland should not be more than 0.4 m. So, when compared to the criteria for growing oil palm, peatland is not suitable for oil palm. But according to Minister of Agriculture Regulation No. 14 of 2009 concerning Guidelines for the Use of Peatlands for Oil Palm Cultivation, peatland that can be used for oil palm cultivation is a stretch of land with a peat depth of less than 3 meters which is contrary to that regulation.

In fact, the use of peatlands, especially for oil palm plants can be done by taking into the characteristics of peatlands so as not to damage the function of the environment and encourage greenhouse gas emissions. On the other hand, oil palm plantations are one of the supporting economic growth as a source of foreign exchange and improving the welfare of the community. In 2017 it generated foreign exchange of USD 22.9 billion, equivalent to IDR 239 trillion. In addition, the existence of a moratorium on oil palm plantations has a negative social and economic impact on Indonesia. The results of a study by the University of Indonesia's Economic and Community Research Institute (LPEM) estimated, losses during the five years of the enactment of PP 71/2014 jo PP 53/2016 concerning Peat Ecosystem Protection and Management reached USD 5.72 billion or IDR 76.04 trillion due to the reduction in the area of industrial timber plantations (HTI) and plantations, especially oil palm in Indonesia. This loss comes from reduced national GDP, community income, and reduced labor. Community income is reduced by IDR 4.9 trillion per year. In addition, there was a reduction of 134 thousand workers over the next five years which would lead to new social problems, especially in Riau Province. Social conflicts also occur because of this moratorium, especially between companies and communities, where the community is the plasma of the company. Prior to the moratorium, companies could open their plantations on oil palm, but after the moratorium, the community's oil palm plantations that were being opened by the company were eventually abandoned by the company. This is done by the company because there were no restrictions before. After a moratorium, the company finally left the land, the community was finally confused, because the land being opened, was abandoned by the company. Finally the community asked the company to continue the work, but the company still refused. This results in conflict between the two parties. Not a few of the company's inventories in the field were eventually abandoned by the company and eventually used by the community (Falatehan et al 2012).

Finally, the stakeholders of the plantation industry, especially oil palm, urged Presidential Instruction No. 10/2011 concerning Postponement of the Provision of New Permits for Primary Natural Forests and Peatlands no longer extended. The reason is that it will hamper the investment

climate and multiplayer effects of the palm oil industry in regions such as employment. Although on the other hand, the moratorium is considered to be successful in reducing deforestation rates.

The Comparison of the financial feasibility of oil palm plantations on peat and non-peat land

This section analyzes the comparability of the feasibility of oil palm plantations, based on the research of Herman et al. 2009. Oil palm plantations on peatlands, according to Yudoyono et al in 2016., it is able to produce fresh fruit bunches (FFB) 23.74 t/ha/year. The similar results are stated by Setiadi in Barchia (2006), that oil palm on peatlands is capable of producing FFB 20.25 t/ha/year. As a comparison, according to Lubis in 2008 , the exploitation of oil palm on mineral land can produce an average FFB of 22.26 t/ha/year with a peak production of around 27.32 t/ha/year.

This study analyzes the development of one oil palm plantation business unit on mineral and peat land with a plantation area of 6,000 ha . The pattern developed for these two feasibilities is the core plasma partnership model, which requires investment costs for one unit of palm oil processing plant is IDR 256.66 billion in mineral land and IDR 276.82 billion in peatland. The investment costs on peatlands are slightly higher than on mineral lands, this is because peatland management requires drainage channels, road compaction, and more intensive bridge/culvert construction than mineral land.

Table 2. The Investment Costs for the Development of Oil Palm Plantations in 2008

No	Land type / cost	Cost (IDR million)
1	**Mineral land**	40.762
2	Core garden investment[1]	76.015
3	Investment in factories, offices, housing etc..[2,3]	11.678
4	Overhead costs[2,3]	128.402
5	Plasma plantation investment[1]	256.857
6	Total investment	
7	**Peatlands**	44.839
8	Core garden investment[1]	78.415
9	Investment in factories, offices, housing etc..[2,3]	12.325
10	Overhead costs[2,3]	141.242
11	Plasma plantation investment[1]	276.821
12	Total investment	40.762

[1]Decree of the Director General of Plantations No24/Kpts/RC.ll0/02/2008 and No 60/Kpts/RC.110/4/08
[2]Pahan (2006);

Based on the assumptions, limits, and investment costs and operational costs, NPV, IRR and BCR are generated. The three business feasibility parameters show that the exploitation of oil palm on mineral and peat land is quite feasible. If the CPO price is assumed to be IDR 10,000/kg and the palm kernel price is IDR 6,500/kg, then the price of fresh fruit bunches (FFB) is IDR 1,500, then the NPV value is obtained for farmers with an area of 1 hectare, the NPV value of farmers in mineral fields is around 10% higher than that of peasants on peatlands, as well as the NPV of the company with an area of 1,500 hectares, the NPV value of the company on mineral lands is higher around 3.5% compared to peatland.

The IRR value for oil palm exploitation in mineral fields is higher than that in peatlands. The IRR value for farmers in mineral fields is about 7% higher, while for companies, the IRR value is 4% higher for oil palm cultivation on mineral land. In line with the previous analysis, the NPV and IRR values for oil palm exploitation on mineral land are higher than peatlands, as well as the BCR value. The difference in BCR values for farmers is around 9.14 percent of farmers on mineral lands higher than in peatlands, while the difference for companies is around 1.5%.

Table 3. Financial analysis of the palm oil plantation partnership pattern with various FFB price levels

Land type / manager	Price of FFB (IDR/kg)	NPV df 15% (IDR million)	NPV df 15% (IDR000/ha/ year)	IRR (%)	BCR
Mineral land					
Farmers (area of 1 ha)	1.500	54	2.146	32,88	2,15
Company (1,500 ha)		231.530	5.513	34,42	1,41
Peatlands					
Farmers (area of 1 ha)	1.500	49	1.979	30,72	1,97
Company (1,500 ha)		223.746	5.327	33,10	1,39

1CPO price of Rp 10,000 / kg, palm kernel Rp. 6,500 / kg with the price level of FFB received by farmers.

FFB = fresh fruit bunches; NPV = net present value; IRR = internal rate of return; B/C = benefit / cost.
Source: Herman et al 2009

The Recommended Model for Sustainable Management of Oil Palm Plantations in Peatlands

The Peatlands in Indonesia are still very wide, reaching 13.5 million ha. The concentration of carbon in peat soil is around 30-70 kg/m^3 or equivalent to a thickness of 300-700 tons/ha/m. their function as providers of environmental services, such as water and carbon storage, biological diversity, especially on peatlands that are still naturally vegetated, therefore it must be maintained or conserved. Whereas peatlands that have perishable properties, their utilization must be guided by sustainable land development efforts. The palm oil is one of the commodities that is able to adapt to various types of land, including peatlands. The use of this peatland requires some special techniques so that the growth of oil palm on this peatland can be productive and sustainable. In the utilization of peat there are five techniques that can be done to fix peat soil and acid sulphate soils, so that they can be planted with oil palm.

1. First is the compaction using heavy equipment on peatlands. This is done in order to prepare relatively soft peat soil to be solid and strong to support the palm oil staple.
2. The second technique is regulating water, making and managing plantation trenches.
3. Third is the arrangement of water level. The height of the water should not cause plants to stagnate or lack of water. One way to overcome this is to maintain a water level between 60-80 cm.
4. Furthermore, for fertilization, it is necessary to add sufficient macro and micro fertilizers because peat soil is nutrient-poor soil.
5. Finally, planting on peatlands needs to use varieties with shorter crop stems so that peat soils are able to support tree trunks so they do not tilt.

In addition to these techniques, humic acid can also be added to acid soils, because these compounds can stimulate oil palm growth. But this innovation has not been widely applied by palm oil businessmen, it is only applied to large oil palm plantation companies. This technique requires considerable capital, so that palm oil farmers have not utilized this technique.

Meanwhile, based on a 14 year 2009 Permentan about cultivation of palm oil plantations on peat, a couple of things to note are:

- Planting of oil palm is carried out on a stretch with a minimum peat depth of 3 meters
- Substratum where oil palm is planted is not quartz sand / acid sulphate soil,
- The level of maturity of peatlands at *saprik* or *hemik* level
- Land clearing for oil palm plantations on peatlands must meet soil and water conservation rules
- Peatland opening without burning

The Government through the Ministry of Agriculture No.11/2015, emphasizes the management of peatlands for oil palm plants in the Sustainable Palm Oil Certification System

(Indonesia Sustainable Palm Oil Certification System-ISPO). Some of the principles of the ISPO criteria needed for the cultivation of oil palm plantations on peatlands are:

- Legality of the plantation business including the status of the land used
- Protection of the use of primary natural forests and peatlands
- Environmental management and monitoring
- Land rights: plantation companies must have land rights in the form of HGU
- Plantation location: plantation land use is in accordance with the RTRW at the provincial and district levels

Therefore, the actual planting of oil palm on peatlands can be carried out, but some things as mentioned before need to be done so that the palm oil plantation area becomes an environmentally friendly and sustainable oil palm business.

3. Conclusion

Based on the research conducted, the following results are obtained.

1. The development of oil palm plantations has a positive impact on economic conditions and social conditions. Social problems arise between companies and communities in the management of oil palm plantations when the government issues a licensing moratorium on the opening of oil palm plantations on peatlands due to fires in Indonesia.
2. Based on the feasibility analysis, the exploitation of oil palm on peatlands is beneficial even though the exploitation of oil palm in peatlands is of lower benefit compared to exploitation on mineral land.
3. The management of oil palm plantations can be carried out on peatlands, but several things need to be considered in the operation, especially in water management. Sustainable management of oil palm plantations on peatlands is very necessary, because peatlands are easily damaged land.

Palm oil is one of the leading commodities in Indonesia. Government benefits, oil palm companies and communities from these commodities are not small. Therefore, there are not a few companies and communities that cultivate oil palm on peat land, which is easily damaged land. The management of oil palm on peatland may be done, but there are several techniques or considerations that need to be considered in the operation. This technique is expected to be a way of preserving nature and utilizing parts of unproductive land in Indonesia to support energy independence. By implementing the appropriate compaction techniques, good water management, optimal water level management and fertilization and planting using varieties with shorter crop stems, it is hoped that the management of palm oil in Indonesia can achieve sustainable palm oil management in accordance with the concept of sustainable development.

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