International Invention Journal of Arts and Social Sciences (ISSN: 2408-7238) Vol. 4(2) pp. 31-42, April, 2017
Available online http://internationalinventjournals.org/journals/IIJASS

Full length Research Paper

Economic Gains and Losses of Sustainable Smallholder Oil Palm (*Elaeis guineensis Jacq.)* Plantations on Peatlands in Indonesia

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Received 13 March, 2017; Accepted 14 April, 2017

Oil palm smallholders on peatlands have contributed significantly to economic development in rural areas by augmenting income and reducing poverty, among other developments that increase economic growth. However, they also cause adverse environmental impacts such as carbon emission, haze and peat fires, deforestation, water supply disruption, and biodiversity loss. The objective of the study was to determine the economic gains and losses of developing sustainable smallholder oil palm plantations on peatlands in Siak District Riau Province, Indonesia. A cost-benefit analysis was used to determine the economic impacts of the smallholder oil palm plantations. Results revealed that development of 94,726 ha oil palm smallholder plantation on peatlands has generated an estimated 37,326 jobs and increased the average total income of smallholder households to USD 4,556 per year. Total benefit from smallholder oil palm plantations was computed at USD 604,360,885 per year. However, smallholders have not implemented sustainable oil palm cultivation on peatlands, which has led to negative effects on the environment. It was estimated that USD 1,115,694,242 is lost per year due to the adverse environmental impacts such as carbon emission, deforestation, water supply disruption and biodiversity loss, among others. Economic analysis showed that the total economic value is USD -511,333,357. It indicated that the current situation of smallholder oil plantations on peatland in Siak leads to be greater social cost than social benefit. Proposed policies should encourage sustainable oil palm plantations characterized by a synergistic relationship among legal, social and financial aspect in order to provide optimal economic impacts to communities and minimize adverse effects on the environment. Total economic value of implementation of sustainable smallholder oil palm plantations on peatlands was computed at USD 636,629,211. This indicates that the development of sustainable smallholder oil palm plantations can provide a positive impact on the economy and the environment.

Keywords: *Oil Palm, Smallholders, Peatlands, Sustainable.*

INTRODUCTION

Oil palm is one of the strategic agricultural commodities of Indonesia, serving as one of its economic pillars. It is a major contributor to job generation, increasing income and promoting economic development and reducing poverty incidence in the rural areas, among others (Syahza, 2012; Wahyunto et al., 2013).

Increased demand for palm oil in the world market has attracted big companies and smallholders alike to invest in oil palm plantations. This has increased the demand for land for such purpose. Peatlands can be an alternative site for oil palm plantations as long as

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technical conditions are met and are financially feasible for oil palm cultivation (Rahutomo et al., 2008).

The development of oil palm plantations on peatlands, however, has various adverse effects on the environment. Currently, there is an ongoing debate as regards its main impacts on the environment and the economy, which will affect the welfare of the communities. The primary issues against oil palm plantation on peatlands include the significant carbon stock and greenhouse gas emissions, tropical peatland deforestation, biodiversity loss, and fire, air, and water pollution (Norwana et al., 2011). Among these issues, greenhouse gas (GHG) emission is considered the main concern, as peatlands are capable of storing large quantities of carbon and thus can potentially emit large amounts of GHG, which contribute to global warming and climate change (Schrier et al., 2013). The deforestation of peatland forests in Indonesia is also being blamed on the development of oil palm plantations (Hooijer et al., 2006). In addition, the conversion of peatlands to oil palm plantation can affect hydrology and water storage such as soil subsidence, flood, and salt water intrusion (Page et al., 2010; Silvius et al., 2000). It can also lead to the loss of ecosystem services and biodiversity (Koh and Wilcove, 2009). They also cause air pollution from haze resulting from forest and peat burning during land preparation that affects human health (Tacconi, 2008).

There are however concerns regarding the development of oil palm plantations considering that the economic benefits to the country in general and the communities, in particular, may be attained at the issues. Moreover, these adverse impacts are not limited to the locality but also have effects at the regional and global levels (Schrier et al., 2013). Peatland conversion loss is likely to cause greater losses than gains from oil palm plantation development (Obizinki et al., 2012). Hence, oil palm development should consider the environmental aspects in order to minimize environmental impacts and achieve sustainable economic development. This study was conducted to determine the economic gains and losses of smallholder oil palm plantations on peatlands in Indonesia.

METHODS

The study was conducted in the province of Riau, which has the largest peatland areas in Indonesia. Using purposive sampling, Siak district was chosen since it has the largest area devoted to smallholder oil palm plantations on peatland in Riau. Both primary and secondary data were utilized in this study. Cochran Sampling Technique was employed in selecting the smallholder-respondents.

$$n = \frac{\frac{Z^2 P.Q}{d^2}}{1 + \frac{1}{N}\left[\frac{Z^2 P.Q}{d^2} - 1\right]}$$

Where:

N : sample size
P : Proportion of P independent smallholders
Q : Proportion of Q group dependent smallholders
N : Population Size
D : Acceptable samples error (5%)
Z : Z value (1.96 for confidence 95% level)

Cost Benefit Analysis (CBA) was used to evaluate the gains and losses from oil palm plantations in peatlands.

Economic Gains

Production value

Economic gains generated from oil palm production (Fresh Fruit Bunch) value.

PV_{ffb}: ((AQ x P) –TC) x A

where :

PV_{ffb} = Production Value
AQ = Annual Productivity (ton/ha)
P = Price (USD/ton)
TC = Total Cost (USD)
A = Area (ha)

Regional Multiplier Effect

Economic Impact analysis examines the effect of an event on the economy in regional specified area. It measures changes in business revenue, profit, personal wages and jobs. It implied to estimate all of the impacts including direct, indirect, and induced effect in the regional multiplier effect (Weisbrod and Weisbrod, 1997) The impact on regional development can be measured as:

$$k = \left(\frac{1}{(1-(MPC\ x\ PSY)}\right)$$

(Syahza, 2012)

Where:

K = Economic Multiplier effect in the area.
MPC = Marginal Propensity to Consume represents income spent by smallholders in local the area.

PSY = Percentage of plantation input required by smallholders oil palm plantation that is served from the local area.
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Economic Losses

Carbon Emission

Estimates of economic losses due to carbon emission are based on the condition of the technical culture used by smallholders. It determines the number of carbon emissions released. The benefits transfer method was used to estimate the economic losses from carbon emissions. In this study, the valuation of economic losses was based on the price of CO_2 emission equal to USD 4.9 per ton, in accordance with the ecosystem marketplace in 2014 (Bloomberg Business, 2014),

CEV = CER x SCP

Where :

CEV = Carbon Economic Value
CER = Carbon Emission (ton/ha)
SCP = Price (USD/ha)

Deforestation

The economic losses due to deforestation based on the potential stumpage value of peat forests were estimated using the formula:

StV = VDS x V x P
V = ½. Π. d^2.h.Cf

Where :

StV = Stumpage Value (USD)
VDS = Vegetation Density Structure (population)
V = Volume (m^3)
P = Standard Price in the market
D = diameter (m)
H = Height (m
Cf Coefficient Factor

Water Supply

Loss of peatlands' environment causes a disruption in the hydrological system, as manifested in the decreasing availability of water during the dry season and floods during the rainy season (Page et al., 2010). The equation for estimating decreasing water availability and flooding is:

LEV = ([ETc_{op} – $ETcC_f$] x P x A)
ETc=kc x ETP (Widodo and Bambang, 2010)

Where :

LEV = Loss of environmental economic value due to hydrological system disruption
ETc_{op} = Oil palm evapotranspiration coefficient
ETc_f Forest evapotranspiration coefficient
P = price of water (USD/m2)
A = Area
Kc = Crop coefficient

Health (haze)

Exposure to haze has an impact on health, such as upper respiratory tract infection (URTI), asthma, bronchitis, painful and watery eyes, chest pains, and skin allergies (Guyon and Simorangkir,1998). The health cost was estimated based on the Cost of Illness (COI) that included the treatment cost and estimated workday lost (Otman and Shahwahid, 1999). Losses from illnesses caused by haze were estimated using dose-response function methods employing the Air Pollution Index (API) taken from Air Monitoring Service data covering the periods from Jan – Dec 2014. (Table 1).

The total treatment cost can be estimated using the formula:

TCTST = (NT x PT) + (NST x PST)………………… (1)
NT = $\sum_i CHL_i$ x DRC_1xHD_ix POP_1 /10,000…… (2)
NST = $\sum_i$ CHL_1 x (DRC_1+ DRC_2)x POP_1 /10,000 HD_ix F_1 x F_2………………… ……………………… ………(3)

Where :

NT = The incremental number seeking treatment in the area (person)
NST = The incremental number seeking self-treatment or directly buying medicine in the area (person)
CHLi = The difference between the average haze index in state I and the normal haze index of 25
DRC_1 = The dose response coefficient per 10,000 population for the number of hospitalized cases in public hospitals.
DRC_2 = The dose-response coefficient per 10,000 population for the number of out- patient treatment cases in public hospitals.
HDi = The number of hazy days in area (days)
F_1 = The factor of those seeking out-patient treatment in the area
F_2 = The factor of those seeking self-treatment

Table 1. Air Pollution Index Indicators

AIR POLLUTION INDEX	DIAGNOSIS
0 - 50	Good
51 – 100	Moderate
101 – 200	Unhealthy
201 – 300	Very unhealthy
301 – 500	Dangerous

Source : Otman and Shahwahid, 1999

in the area

F_2 = The factor of those seeking self-treatment in the area

POPi = The population of those seeking self-treatment in area i

TCTST = The total cost of treatment and self-treatment (USD)

PT = The price of out- patient treatment and medication (USD)

PST = The shadow cost of self-treatment (USD)

A loss in productivity was estimated using the formula:

TPLI = TNWDL x W (4)

TNWDL = NWDL + NSL +NRAD (5)

NWDL = NA x AAR x LH (6)

NSL = ATR x NT x LMC x MCR (7)

NRAD = (NT+NST) x ATR x LRA-NWDL-NSL) x F3 (8)

NA = $\sum_i CHL + DRC_2 + HD_i x F_2 x Pop_i/10,000$ (9)

NDA = NA x LH (10)

CA = NDA x PH (11)

Where :

TPLI = Total productivity losses from illness (USD)

TNWDL = Total workday lost (days)

W = Average Wage per employee (USD)

NWDL = The incremental number of workdays (days)

NSL = The incremental number of days of sick leave to adult out-patient (days)

NRAD = The incrementally reduced activity (days)

NA = The incremental number of patients hospitalized (person)

AAR = The percentage of adult patients admitted to hospital (%)

LH = The average length of stay in hospital (days)

ATR = The proportion of adults seeking treatment (%)

MCR = The proportion of the proportion of out-patients seeking treatment and obtaining sick leave (days)

NRAD = The number of work days lost by workers at risk (days)

LRA = The number of reduced productivity days experienced by individuals at risk (days)

F3 = The factor for reduced productivity for individuals at risk but still working

NDA = The total number of days of hospital admission throughout the country (days)

CA = The incremental cost of hospitalization (USD)

PH = The price of hospitalization per day (USD)

Biodiversity

The estimated value of biodiversity loss using the benefits transfer method was US$ 30 per hectare (ISAS cited in Tuccony et al., 2003). This value, however, is not fully reflective of the real loss due to the difference in local conditions.

Estimated Total Economic Value

$$TEV = \sum OP - (\sum EC + \sum DF + \sum PF + \sum WS + \sum BD)$$

TEV = Total Economic Value (USD)

OP = Oil Palm Production Value (USD)

EC = Emission Carbon Loss (USD)

DF = Deforestation Loss (USD)

PF = Peat Fires and Haze Loss (USD)

WS = Water Supply Disruption loss (USD)

BS = Biodiversity loss (USD)

The assumptions used in this analysis are:

1. Economic analysis of developing oil palm plantation on peatlands covered a 25 year period.
2. The land area used in the analysis is the whole of oil palm smallholders' plantation areas on peatland in Siak covering 94,726 ha.
3. The quantifiable benefit was based on the net benefit value of developing oil palm plantation on peatland and its multiplier effect is not included in estimating.
4. The economic cost includes the social cost of carbon emission, peatland fire on health, loss in farm

productivity due to illness, deforestation, water supply, and biodiversity loss.
5. The official exchange rate in 2014 was approximately IDR 12,000 per USD while the foreign exchange premium was IDR 20%
6. The social opportunity cost of capital in Indonesia is 12%.

RESULTS AND DISCUSSION

The oil palm development program of the Siak government aims to boost economic growth and improve the welfare of society, especially in rural areas. Loss of natural forest resources caused by illegal logging contributes to the increase in poverty. The Poverty, Ignorance Eradication and Infrastructure programs aim to alleviate poverty in rural areas through the development of oil palm plantation.

Based on the data from the Forestry and Estate Agency of Siak, there was 134,178 ha of oil palm plantations on peatlands in Siak in 2013 of which 70.6% (94,726 ha) were smallholders' plantations (Table 2). Based on the Cochran sampling technique, the total of 273 respondents was selected for the study. The two type of oil palm smallholders on peatlands in Siak are the dependent/plasma/supported and independent smallholders. Dependent or supported smallholders are those who participate in the government's oil palm plantation development programs that may be implemented through a system of partnerships with plantation companies. Independent smallholders are those who develop their plantations through their own efforts; they self-finance, manage, and equip their plantations and do not transact with any of the palm oil milling companies.

The average area of land owned by the 273 smallholder-respondents was 3.04 ha, with values ranging from 1.5 - 9 ha. Smallholders acquire peatland areas for oil palm plantations through various means, most of them by purchase (56.41%). The information provided by key informants indicate that the land acquired through purchase include lands with expired concessions and industrial timber plantation, as well as degraded peatlands due to illegal logging. Ambiguity and obscurity in the government policy for Regional Spatial Plan(RTRW) allowed the unauthorized sale of peatland forest areas to the smallholders. The second form of acquisition is through land conversion of paddy fields, rubber plantations, and other crops (12.82%). Other forms of the acquisition include forest clearings (9.89%); expired concession and industrial timber plantations (6.96%); public forest area (5.49%).

Stratified sampling was used to choose smallholder respondents that planted oil palm over different periods (based on oil palm age)(Planting years refers to smallholders planting oil palm in different periods starting 1998 until 2014; 250 samples whose mature crops (1998-2010)) and others who have immature crops (2011-2014). Average production was 40.14 tons per smallholder. Hence, the average productivity (planting year 4-14 years) was 13.60 tons per ha per year.

Economic Gains

Oil palm development programs provide economic benefits to the communities and surrounding areas. The economic gains from developing oil palm plantation on peatlands include generation of new employment, improvement in income and well-being of rural communities, and the multiplier effects of the additional economic activities.

Potential Employment

Activities related to oil palm development involve a lot of labor. Employment is possible because oil palm smallholders generally carry out their activities manually. Oil palm smallholders in Siak do not perform all operational production activities but hire laborers from outside the plantation.

Results of the employment requirement analysis show that peatlands in Siak generated employment for 37,326 persons (Table 3) with an employment coefficient of 0.44/ha. It means that 2.27 ha of oil palm plantation will generate employment for 1 person. Hence, oil palm smallholders provided the largest share of employment in Siak at 20.50%.

Income of Smallholders Household

The average total income of smallholder households was approximately USD 4,556 per year. Income from oil palm constitutes a very large percentage of the total family income. Based on the analysis of the structure of smallholders' income, the average contribution of income from oil palm to the total household income is 74.40%. Average smallholder income from oil palm plantations was estimated to be USD 3,452 per year, which is 72.03% of the 2013 per capita Gross Regional Domestic Product (GRDP) of Siak amounting to USD 4,793 per year. It is higher than the GRDP, however,

Table 2. Area and Number of Oil Palm Smallholders Plantations on Peatlands in Siak 2013

No	Sub Distric	Area (ha)	Number of Smallholders		
			Dependent	Independent	Total
1	Siak	2,398	374	293	667
2	Sungai Apid	2,484	165	684	849
3	Bunga Raya	13,903	934	3,634	4,568
4	Tualang	16,696	-	4,540	4,540
5	Dayub	18,012	2,299	3,825	6,124
6	Mempura	28,049	966	4,540	6,343
7	Sungai Manday	5,508	143	1,289	1,432
8	Lubuk Dalam	5,853	-	420	2,066
9	Sabah Auh	550	-	196	196
10	Pusako	1,273	1,494	572	420
Total		**94,726**	**6,375**	**20,830**	**27,205**

Source: Estate Crops Agency of Siak, 2014

Table 3. Estimation of Employment Generated in Smallholders Oil Palm Plantations on Peatland in Siak, Indonesia 2014

ITEM	Manpower Requirement (Ha/Year)		Employment (Person)
	Mandays (Person/year/ha)	Manpower (Person/year/ha)	
Smallholders	-	-	27,205
Nursery	3,161	11.00	446
Land Clearing	66	0.22	322
Immature Crops	83	0.28	530
Mature Crops	34	0.11	2,018
Harvesting	-	0.075	5,778
Transportation	-	-	1,027
Total (person)			37,326
Oil Palm Smallholders on Peatland Area (ha)			94,726
Employment Coefficient			0.44
Total Employment in Siak, 2013			182,059
Contribution of Oil Palm Smallholders to Siak Employment			20.50%

regardless of whether it comes from oil and gas, by 119.03% or approximately USD 2,900 per year.

Multiplier Effects

The development of oil palm plantations on peatlands has had enormous economic impacts on rural development in Siak due to the multiplier effects of the additional income. The development of oil palm plantations has generated a lot of jobs for the =surrounding communities and the emergence of business opportunities such as eateries, convenience stores, transportation, workshops, household industries, banking services, and other services. All these have eventually led to the emergence of the market in residential and rural areas, thus increasing income and improving social welfare.

The computation of the multiplier effect is based on household income spent by smallholders in the local region (MPC) and the needs of the oil palm plantation activities that can be met in the local area (PSY). Smallholders generally used the proceeds of FFB for household expenses, while revenues from other business sources were used as savings or investments in oil palm cultivation. The average expenditure of smallholder households was pegged at USD 2,644 per year. The value of the multiplier was computed at 3.01, which means that every USD 100 spent by oil palm smallholders will generate an additional amount USD 301 from auxiliary services.

Problems of Smallholder Oil Palm Plantations in Siak

While the development of 94,726 ha smallholder oil palm plantations on peatlands in Siak may provide enormous economic benefit for Siak's economy, the results also revealed that there are accompanying problems related to their development. These are as follows:

1. *Most oil palm smallholder plantation is on peatlands*.

Peatland area in Siak comprises 53.94% (461,527 ha) of total area are still available for oil palm development. However, among others, there are many environmental challenges in developing them.

2. *Suitable peatlands for oil palm cultivation*.

There are 159,890 ha, which is 34.64% of total peatland areas in Siak, with a peat depth of fewer than 3 meters that is suitable for oil palm cultivation. The rest of the area with a peat depth of at least 3 meters are no longer suitable.

3. Lack of knowledge and low adoption of appropriate cultural practices, as well as the lack of funding.

The application ofBest Management Practices for sustainable palm oil production on peatlands is very crucial for reducing its negative environmental impacts. In this study, 10 indicators were used to determine whether farmers were adopting sustainable palm oil management practices. This is shown in Table 4.

4. Low Productivity

Lack of knowledge, low adoption of recommended cultural practices and lack of funding are the major reasons for the low productivity in smallholder farms. Results show that the average farm productivity was 13.60 tons per ha per year which is only 55.93% of the potential standard productivity. Despite this, smallholders perceive that oil palm production on peatlands is still profitable, thus they continue to expand peatland areas for oil palm cultivation.

Under these conditions, the major challenge in the production of smallholder plantations in Siak is addressing adverse impacts on environments. Results show that only 44.69% of smallholder-respondents applied the best management practices (BMPs).

Economic Losses

While there are economic gains from smallholder oil palm plantations on peatlands, there are also economic losses related to the degradation of environment and losses in social welfare.

Carbon Emission

Economic losses from carbon emission depend on the cultural practices. Results show that the estimated carbon emission released by smallholder oil palm production is 48 – 66 ton CO_2/ha/year. Based on information from "ecosystem marketplace" (Bloomberg Business, 2014), the price of CO_2 emission is USD 4.9 per ton. The estimated economic costs of carbon emission based on the ecosystem age of the oil palm crops are listed in table 5.

Deforestation

The condition of vegetation density structure of plants in the peat forest in 4 research areas was determined by the Regional Planning Agency in 2013 (Table 6). Standard Price of Mix Forest Provision is USD 80.25 per m^3 (Regulation No. 22, Series of 2012 of Indonesia's Minister of Trade). This standard refers to the calculation basis of the forest resources provision that surcharges imposed as a substitute for the intrinsic value of forest products harvested from state forests Thus, the economic value is USD 162.57 per ha.

Palm oil cultivation accounts for 9.89% of total peatland deforestation in Siak (figure 1). Hence, during the 15 years of oil palm development (1998-2014), the economic losses due to deforestation was estimated at USD 101,535,477 per year (Table 6 and 7).

Water Supply

The decline in the water supply is one of the economic losses that is attributed to the development of oil palm plantations, particularly, during the dry season (June, July, August) when there is a deficit of 50 mm/ha/year (Figure 2). This means that as much as 500 m^3/ha/year of water is lost for every 1 ha of oil palm plantation developed.

Based on data obtained from the Regional Water Company SiakTirta, the price per m^3 of water is USD 0.402. Thus, given a 94,726-ha of peatland areas developed to oil palm plantations by smallholders, the estimated value of the reduction in water availability is USD 19,028,085 per year.

Peat Fire

The economic losses from peatland fires consist of the cost of treating haze-related illnesses, the relief fund from the government to assist victims of these fires and loss of productivity of these smallholders. The total economic costs from peatland fires is estimated at USD 3,952,714 per year. This consists of treatment costs valued at USD 2,647,271, the relief fund valued at USD 833,333 per year that is provided to the Budget of Regional Disaster Board for Disaster Management for Haze Catastrophe by the Anggaran Belanja Pendapatan

Table 4. Number of Smallholder Respondents who Implemented the Sustainable Oil Palm Plantations in Siak 2014

Indicator	Applied		Did Not Apply	
	No	%	No	%
Identification of Land Suitability	135	49.45	138	50.55
Zero Burning	144	52.75	129	47.25
Using High Yield Planting Material	122	44.69	151	55.31
Compaction	118	43.22	155	56.78
Water Management	95	34.80	178	65.20
Balance Fertilization	25	9.16	248	90.84
Integrated Pest Management	21	7.69	252	92.31
Using Cover Crop	24	8.79	249	91.21
Road Maintenance	269	98.53	4	1.47
Prevention and Control Fires	267	97.80	6	2.20
Average Implementation		44.69		55.31

Table 5. Estimated Economic Losses of Carbon Emission Released by Oil Palm in Siak 2014

Age of Oil Palm	Estimation of Emission Carbon Released (CO2/ha/year)	Economic Cost of Carbon Emission (USD/ha/year)
0-3	48.69	238.60
4-9	56.19	275.34
10-15	62.73	307.36
16-25	66.30	324.87

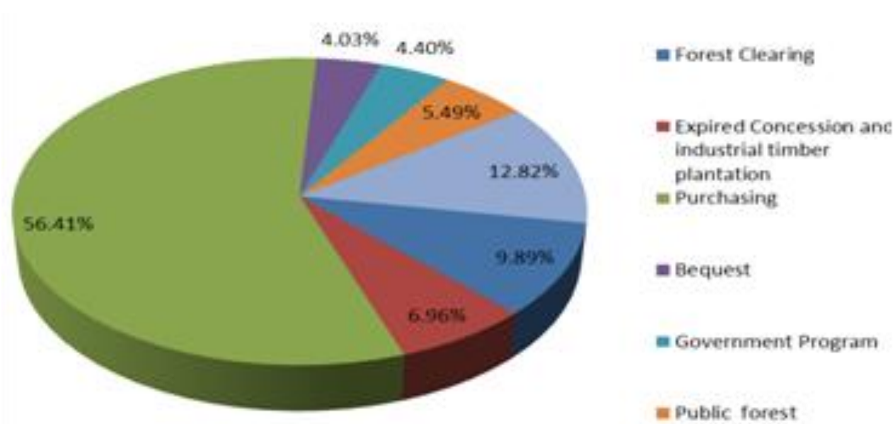


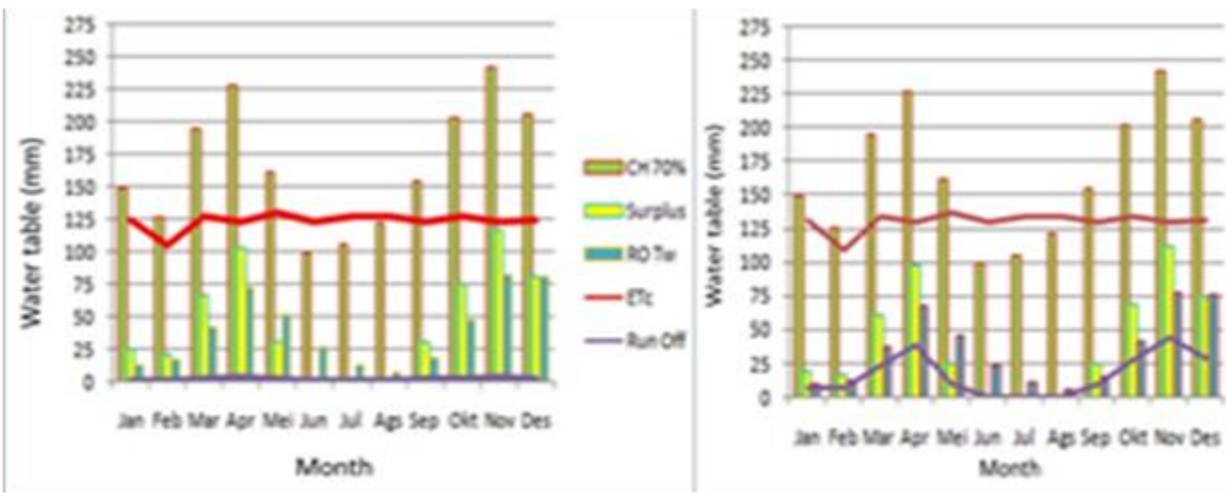
Figure 1. Acquisition of peatlands for oil palm cultivation of smallholders

Table 6. Plant Vegetation Density Structure for Four Research Sites in Siak 2014

Research Area	Population/Ha			
	Tree	Pole	Pile	Tiller
MerempanHulu	100	250	383	225
Dayun	65	180	245	245
Bunga Raya	27	187	262	187
Sungai Mandau	120	195	180	190
Average	78	203	268	212

Table 7. Estimated Stumpage Value per Ha of Deforestation in Siak 2014

Plant Vegetation Structure	Volume/ Tree	Population/Ha	Total Volume
Tree	44.31	78	3,456
Pole	16.88	203	3,427
Pile	4.40	268	1,178
Tiller	0.20	212	42
Total Volume (m3)			2,026
Price (USD/m3)			80.25
Stumpage Value (USD/Ha)			162,569
Estimates of Deforestation due to Oil Palm (ha)			9,368.51
Economic Value			1,523,032,155
Economic Value Per year			101,535,477



Source:Widodo and Bambang, 2010

Figure 2. Water table before oil palm plantation a) and after oil palm plantation (b) in the research site

Belanja Daerah (APBD)/Regional Government's Revenue and loss in farm productivity valued at USD 1,305,444 per year. (Table 8).

Biodiversity

Using the benefit transfer method, the estimated value of the biodiversity loss from oil palm development is estimated at USD 30 per hectare. This value is based on the study of ISAS (cited in Tuccony, et al., 2003). Considering the difference in biodiversity, the value may not be exactly accurate but it can be reflective of the potential value of the biodiversity lost. Given therefore a 94,726 ha peatland area, the estimated economic loss due to the conversion of these areas into oil palm plantations is USD 2,841,780 per year.

Economic Viability of Smallholder Oil Palm Plantation on Peatlands

Results of the economic analysis show that the total economic value is approximately USD -511,333,357. Thus based on basis of such findings it can be said that the current situation of smallholder oil palm plantations on peatlands in Siak leads to greater social cost than social benefit. (Table 9).

Proposed Development Policies for Sustainable Smallholders Palm Oil Plantations on Peatlands

Sustainable methods of production in peatlands should be adopted by smallholders to mitigate the adverse

Table 8. Estimated Total Economic Losses Caused by Peat Fires in Siak 2014

Item	Economic Losses (Usd/Year)	Social Cost Per Ha (Usd/Year)
Treatment Cost	2,647,271	27.95
Cost of treating Illness	1813,937	19.15
Disaster Relief Fund	833,333	8.80
PRODUCTIVITY	1,305,443	13.78
Total	3,952,714	41.73

Table 9. Economic Analysis of Gains and Losses of Smallholder Oil Palm plantations on Peatlands in Siak 2014

Item	NPV (USD)
Benefit	
- Net Benefit Oil Palm	604,306,885
- Total	**604,360,885**
Cost	
- Carbon Emission	203,700,926
- Healthy	20,901,948
- Incremental Productivity from Illness	10,307,339
- Deforestation	708,107,010
- Biodiversity Losses	22,437,728
- Water Supply	150,239,290
-Total Cost	**1,115,694,242**
N P V Total Economic Value (USD)	**-511,333,357**

effects of oil palm plantation development such as carbon emission, soil subsidence, peatland fire, biodiversity, and deforestation. However, results show that only 44.69% of smallholder-respondents applied Best Management Practices (BMPs) (table 4). The main reasons as mentioned earlier were the lack of technical information and awareness of the appropriate cultural practices as well as the lack of funding. In addition, there are issues related to uncertainty in the regional spatial plan (Rencana Tata Ruang Wilayah (RTRW), lack of law enforcement, the slash and burn method of land clearing which often triggers peatland fires and cultivation of forest area reserves for palm oil plantations.

Given these concerns, there is a need for a policy on sustainable oil palm development on peatlands that will consider the legal, social, and financial issues that will enhance the economic benefits to the communities while minimizing the adverse impacts on the environment (Figure 3).

This will include the establishment of RTRW and strengthening of law enforcement to encourage oil palm plantation development on peatlands. It would be best also to divide the oil palm plantations into zones where some agricultural commodities with good market prospects can be established to support the region's economy. Furthermore, free prior information is needed to ensure that the smallholder oil palm plantations are not in the peat forest areas. In addition, there is a need to raise social awareness as well as capacitate smallholder institutions to ensure compliance with the sustainable development of oil palm plantations. This will involve capacity building programs based on Indonesian Sustainable Palm Oil (ISPO) and Best Management Practices (BMP). Lastly, there is a need to provide incentives for smallholders on the implementation of sustainable oil palm plantations and preservation of ecosystems. In addition, financial incentives such as a premium price for FFB can be granted to smallholders who implement sustainable oil palm production based on the standards set by the Indonesian Sustainable Palm Oil (ISPO).

The results of the economic analysis of implementation BMP presented in table 10that mitigation of the adverse environmental impacts of oil palm plantations on peatlands is positive. It indicated that the development of sustainable smallholder oil palm plantations can provide a positive impact on the economy and the environment. (Table 10).

CONCLUSIONS

Smallholder oil palm plantation on peatlands provides enormous economic net benefits for Siak's economy. It is, therefore, important to reconsider the moratorium of oil palm plantations on peatlands, particularly for smallholder oil palm plantations development. The

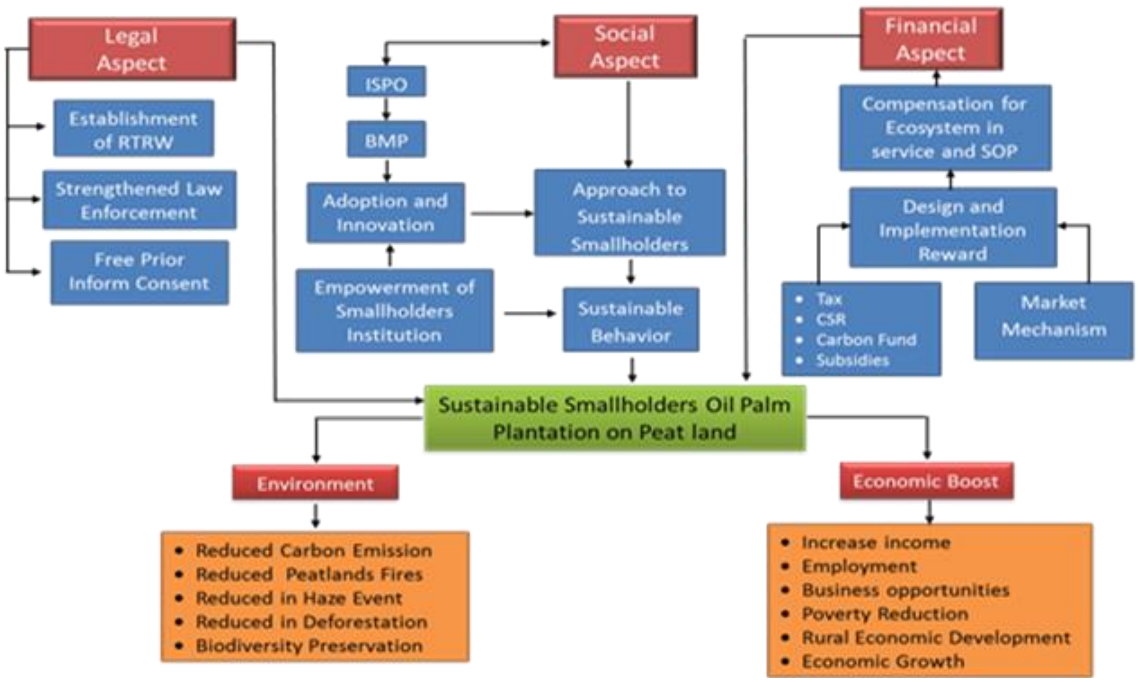


Figure 3. Policy of Developing Smallholder Oil palm Plantations on Peatlands

Table 10. Economic Analysis of Mitigating the Adverse Environmental Impacts of Oil Palm Plantations on Peatlands

Item	Value
Benefit (USD)	
Current Situation (Without Sustainable Development)	604,360,885
With Sustainable Development	1,255,728,578
Incremental Benefit Oil Palm Plantation	**651,367693**
Incremental Social Benefit With The Project	
Reduced Environmental Impacts	**96,318,197**
- C02 Emission	65,108,909
- Healthy (Air Pollution)	20,901,948
- Incremental Productivity from illness	10,307,339
Total Incremental Benefit (USD)	**747,685,890**
Incremental Cost (USD)	111,056,679
Economic Analysis of Incremental Sustainable Oil Palm	
NPV (USD)	636,629,211
BCR	3.66
IRR (%)	44.32

considerations are as follows:
1. The economic benefits from oil palm plantations are crucially important for indigenous peoples in remote areas that have limited sources of income. With the degradation of peatlands and deforestation, these people are losing their source of livelihood. Oil palm can be an alternative source of livelihood as well as the agent of economic development in these areas.
2. As a result of the moratorium, there are illegal conversions of peatlands into oil palm plantations particularly on the independent smallholders which is causing the widespread degradation of peatland areas with the consequent adverse environment impacts.
3. Attention should be given to the suitability and environmental aspect of peatlands. The peatland areas where oil palm plantations will be established should be

carefully considered since not all peatland areas are suitable for such plantations. Therefore, the potential contribution to the economy can be maximized while minimizing the adverse impacts on the environment from peatland degradation.

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How to cite this article: Agustira MA, Ranola RF (2017). Economic Gains and Losses of Sustainable Smallholder Oil Palm (Elaeis guineensis Jacq.) Plantations on Peatlands in Indonesia. Int. Inv. J. Art. Soc. Sci. Vol. 4(2):31-42