

Towards zero burning peatland preparation: Incentive scheme and stakeholders role

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Manuscript received: 29 March 2018. Revision accepted: 29 June 2018.

Abstract. Murniati, Suharti S. 2018. Towards zero burning peatland preparation: Incentive scheme and stakeholders role. *Biodiversitas* 19: 1396-1405. Zero burning during peatland preparation should be implemented to prevent disturbance of its natural biodiversity as well as to minimize the triggering factors of forest fire incidents in Indonesia. The objective of the research is to study method and cost of peatland preparation, alternative incentive schemes to be applied in order to facilitate zero burning farming as well as to identify potential stakeholders involved in the implementation of the incentive. The research was done in Siak District, Riau Province during May to December 2016 through field observation and interview. Two groups of respondents interviewed in the research, i.e., peatland farmers (40 respondents) and officials of related institutions (32 respondents), who were selected through purposive sampling method. The results showed there were three methods of peatland preparation at the research sites practiced by the farmers: (i) Under control burning, (ii) Zero burning, manually and (iii) Zero burning, mechanically. Actual cost of zero burning is significantly higher or more than two times than that of under control burning method. Therefore, there is a need to provide the smallholders peatland farmers with an incentive scheme to support zero burning practice. Margin of cost between zero burning (manually) and under control burning of peatland preparation methods is recommended to be used as standard for incentive. The incentive should be in the form of compulsory programs and applied gradually to assure zero burning peatland preparation widely implemented. Potential stakeholders involved and their commitment to implement the incentive scheme should be encouraged.

Keywords: Burning and zero burning technique, incentive scheme, peatland preparation, stakeholders

INTRODUCTION

Indonesia has about 14.9 million ha of peatland spreading across three big islands, i.e., Sumatra, Kalimantan and Papua (BBPPSDLP/Balai Besar Penelitian dan Pengembangan Sumber Daya Lahan Pertanian 2011), which was reported to be the country having the largest peatland area throughout Southeast Asia (Noormahayu et al. 2009). However, it was also reported that 6.6 million ha of swamp forest and peatland in Sumatra and Kalimantan are in degraded condition (Miettinen and Liew 2010). Furthermore, Badan Litbang Pertanian (2013) reported that degraded peatland in Sumatra was about 2.5 million ha, and most of them (1.3 ha) were located in Riau Province.

Forest and peatland fire occurred almost every year in Riau Province, Indonesia has become a major threat of the swamp forest and peatland ecosystem thereby deteriorating its biodiversity. Murdiyarso and Lebel (2007) and Anwar et al. (2010) reported that biomass burning used as a sanitation practice mostly linked with land clearing activities or preparation of peatland agriculture. Forest and land fire in Indonesia are caused by multiple aspects covering technical, structural and cultural. The main cause behind this havoc was human activities where 95% of fire incident triggered by slash and burn practice and human neglect (Akbar 2015). Page and Hooijer (2016) concluded that to reduce future fire risk as part of wider peatland management strategies, land management options should

be advocated.

Communities, who are living surrounding forest areas, have practiced burning of peatland since long time ago because they were convinced that this process will improve the peat soil fertility. In addition it is a low cost and easy way to clean the land (Murniati et al. 2018). On the other hand, Worrall et al. (2010) mentioned that peatland habitats are complex mosaics of inter-linked vegetation supporting a variety of flora and fauna. By applying prescribed burning, it will alter the natural state of peatland by contributing to this mosaic and by preventing scrub invasion. Furthermore, Ardhana (2016) reported that forest fires occurring continuously throughout the year implicated in the extinction of species diversity, genetics, and ecosystems. Cole et al. (2015) suggested that it is crucial to develop management strategies that foster resilience in the remaining peat swamp forests and to ensure continued provision of carbon storage services. In addition, Saharjo (2010) also reported that burning of peat grass produced more trace gasses (CO, CH₄, N₂O, CH₃Cl, CH₃Br, and CH₃I) than Imperata grassland and peat soil due to the high moisture content of the peat grass.

Zero burning is becoming an effective approach to prevent forest and peatland fire that should be adopted by communities, which is beneficial to minimize the triggering factor of forest and peatland fire. However, zero burning method is predicted to be more expensive. In addition, crop yields cultivated on peatland without burning were

significantly lower than those of burning (Murniati et al. 2018). Therefore, an incentive scheme is needed to encourage the community to practice zero burning method in peatland preparation. Keeping in view, the aim of this research was to study method and cost of peatland preparation, alternative incentive schemes to be applied in order to facilitate farmers to practice zero burning peatland preparation, as well as to identify potential stakeholders involved.

MATERIALS AND METHODS

Study area

Location of the research was Siak District in Riau Province, Sumatra, Indonesia. The Siak District is laid from $0^{\circ} 20' 49''$ to $1^{\circ} 16' 30''$ North Latitude and $100^{\circ} 54'$

$21''$ to $102^{\circ} 14' 59''$ West Longitude. Siak has tropical climate; the air temperature is between $25-32^{\circ}\text{C}$ (Central Statistics Agency of Siak District 2017). The capital of Siak District is Siak Sri Indrapura, about 74 km to the North West of Pekanbaru (Capital city of Riau Province). The research was done in four villages, namely Tuah Indrapura (belong to Bunga Raya Sub-district), Sungai Mempura (Mempura Sub-district), Mengkapan (Sungai Apit Sub-district) and Dayun (Dayun Sub-district) (Figure 1). Reasons for choosing those sites were most of the areas of the four villages are peatland and there was an incident of huge area burned during 2015. Besides that, the research was also carried out at 16 institutions in Regional Government of Riau, Local Government of Siak and the Village Administration. The research was done from May to December 2016.

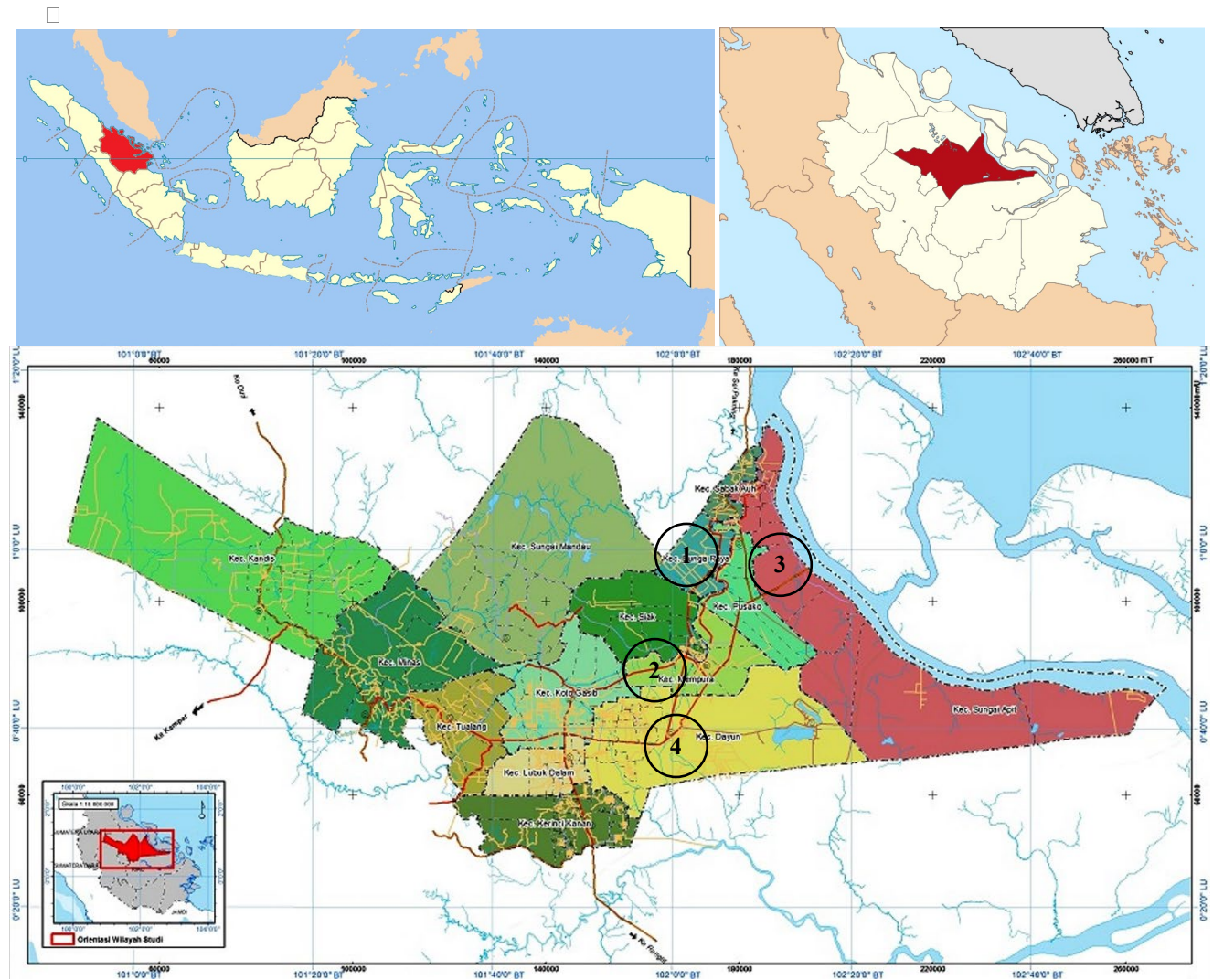


Figure 1. Map of the research site, four villages in Siak District, Riau Province, Indonesia (○ are research villages: 1. Tuah Indrapura, 2. Sungai Mempura, 3. Mengkapan, and 4. Dayun)

Design of the research

Definitive research sites were determined through a series of discussion with the officials of Forestry Services of Riau Province, Natural Resources Conservation Institute of Riau as well as Forestry and Estate Services of Siak District. Research data was collected by means of field observation, in-depth interview and household interview. There were two types of respondents, i.e., peatland farmers who manage their own peatland for farming; and the officials from related institutions having interest in peatland management (stakeholders). They were selected by using purposive sampling method. There were 40 respondent farmers and 32 respondent officials coming from 16 related institutions. Interview with respondent farmers were focused on technique and cost of peatland preparation as well as challenges for adopting zero burning farming. Based on information on margins between burning and un-burning method of peatland preparation and also on farmers' difficulties in adopting zero burning farming, some alternative incentive schemes were formulated. Subsequently, the incentive schemes were used as an entry point to discuss and interview with related stakeholders in order to explore institutions' roles and interest to develop zero burning farming for peatland preparation. Secondary data were collected from several related institutions, such as Statistics of Riau Province, Statistics of Siak District, Forestry and Estate Services of Siak District and Environment Services of Siak District.

Data analysis

Quantitative and qualitative description of data based on technique and cost for peatland preparation as well as farmers difficulties in adopting zero burning farming were analyzed through cross-tabulation. Mapping based data on the prospect of stakeholder roles and their interest in implementing the incentive schemes for zero burning farming on their level of interest and power from each institution was analyzed by using stakeholder analysis (Reed et al. 2009).

RESULTS AND DISCUSSIONS

Coverage area of forest and land burned in Riau

Riau Province has total area of 8.92 million ha with flat topography. About 3.87 million ha or 43.35% of the area is histosol or peatland with organic parent materials. Whereas, Siak District has total area of 828,479 ha and is dominated by wet land (95%) (Central Statistics Agency of Riau Province 2016). According to Direktorat PKHL (2017) and World Bank (2014, 2016), there was a huge area burned in Riau in the past three years, 2014-2016 (Table 1). Based on those two data sources, there are significant differences in coverage area burned. This might be caused by differences in method for data collection and criteria in determining burned area. Furthermore, burnt area in Riau Province only during January-March 2014 measured with Landsat 8 images were already 429,155 ha (Prayoto et al. 2017). It was also reported that shrub land

was the most fire-prone land cover, while plantations and mangrove forest were the least. Most of the burned area in Riau was deforested area expanded by a previous fire or created due to the failure of industrial plantations development (Gaveau et al. 2014). Although it is easy to attribute the source of haze to forest and peatland fire, it is more difficult to identify the cause of the fire. Several factors such as development of large oil palm plantation and slash-and-burn practiced by small farmers due to inability to afford mechanical means of land clearing have been deemed as the major causes of forest and peatland fire in Riau (Musim Mas 2013).

BLH Siak (2015) reported that coverage area of forest and land burned in Siak District during year 2015 was 2,903 ha. The most widely burned was found in Dayun Sub-district (742.5 ha), followed by Bunga Raya Sub-district (443 ha), Kandis Sub-district (356.5 ha) and Sungai Apit Sub-district (279.3 ha) (Figure 2). Musim Mas (2013) highlighted that the fire risk was higher compared to the past (around 1970s) due to significant change in vegetation from drought-resistant natural forests to drought-sensitive secondary forests. As population expands, more people depend on forests for livelihoods, meaning that more people practice slash and burn method to carry out their farming, resulting in higher vulnerable fuel.

Table 1. Coverage area of forest and land burned in Riau Province during year 2014 to 2016

Data source	Area burned (ha)			Total in three years
	Year 2014	Year 2015	Year 2016	
Direktorat PKHL (2017)	6,301	4,041	1,928	12,270
World Bank (2014, 2016)	176,000	139,000	N/A	-

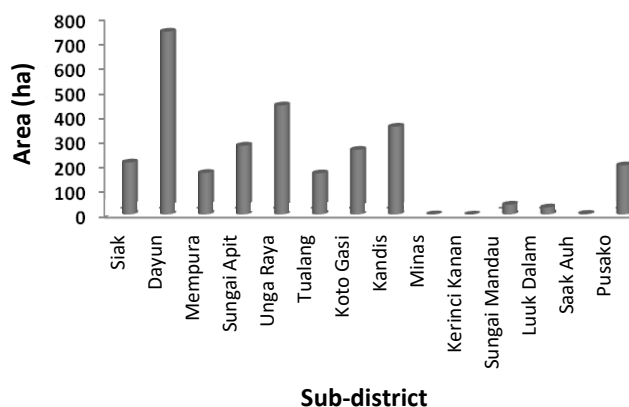


Figure 2. Coverage area of forest and land burned in several Sub-districts of Siak District during 2015. (BLH Siak 2015) (data processed)

Methods for peatland preparation

Communities in Siak District, since long time ago, have utilized peatland for slash and burn cultivation (especially mix garden/*kebun* and *ladang*). On the *kebun*, the communities plant estate crops such as palm oil and rubber, while on the *ladang* they plant food crops, for example, rice, corn, chili, and some kinds of vegetable. This farming system is commonly found in Sumatra Island such as in West Sumatra where rubber plant is planted in Agroforestry system (Murniati et al. 2001). Due to environmental reason, slash and burn techniques especially on peatland during land preparation are often deemed as main contributors to several problems such as landscape degradation and diminishing of household incomes and livelihood options (Chokkalingam et al. 2007).

Regardless of the risks encountered from land preparation using fire on peatland, use of burning technique in land preparation is still commonly found in many parts of the world because it enhances the productivity (Simorangkir 2007) and due to its effectiveness and cheapness (Purnomo et al. 2017). Thoha et al. (2017) stated that fire caused by human activities mostly originated from shrubs swamp burning and land clearing for farming, while hotspot density was determined by peat depth, land cover, accessibility and human activities. However, burning method practiced by farmers at the research sites is under control, since they do not burn vegetation (small trees and shrub) in upstanding circumstances anymore like they had practiced before. The small trees were cut down and slashed. Meanwhile, the shrubs were cleared in strip line and then all biomass were stacked on the certain strip lines. When the biomass becomes dry, it will be burned. This method is called as under control burning. There were three methods of peatland preparation at the research sites followed by the farmers are: (i) Under control burning (as was explained above). This method of peatland preparation was performed by poor farmers who did not apply dolomite or agriculture lime and fertilizer as production inputs. (ii) Zero burning, manually. The land preparation was performed without burning and done manually. The work phases covering cut down the small trees and the stump, spraying herbicide, and finally clearing the land. This method generally was done by middle farmers, who applied agriculture lime and fertilizer. (iii) Zero burning, mechanically. This method can only be carried out by rich farmers, having land more than 10 ha who applied agriculture lime and fertilizer.

Along with the incessant ban of Indonesian Government in practicing burning method (mainly on peatland) since 2014, considerable part of respondent farmers (45%) has practiced zero burning method, either manually or mechanically. However, some of respondents (32.5%) still use the burning method (under control burning) and 15% apply both methods (burning and manually zero burning) in the peatland preparation (Table 2) since they could not afford the higher cost of zero burning practice. This is in line with report from Agustira

and Ranola (2014) that 47.25% of smallholder oil palm farmers on peatland in Siak District did not apply zero burning in the land preparation.

There are lots of reasons for the use of fire in land preparation, but the most prominent motive is economic consideration. There is still the impression that fires are the cheapest, quickest and most effective method of land preparation with additional nutrition benefits from ash residue (Simorangkir 2007). This is in line with farmers' opinion at the research site where 83% of respondents confirmed three reasons why they apply burning in peatland preparation, as reported by Murniati et al. (2018), i.e., (i) It is an easy way and it requires less labor. (ii) It is a cheap way or a low-cost method. (iii) It can reduce peat soil acidity and increase peat soil fertility, thereby application of agriculture lime and fertilizer were not necessary.

Despite the above advantages of using fire in peatland preparation, however, there are some others factors urge us to apply zero burning technique. As mentioned by Prayoto et al. (2017), peatland has an important function in the provision of ecosystem services such as carbon sink, climate regulation, water supply, biodiversity, and others. Recurrent fires in the peatland, have changed peatland functions from carbon sequestration to carbon emission, causing severe environmental and economic problems. Study on impacts of burning management on peatland, Worral et al. (2010) mentioned that burning actually leads to a perpetuation of the heather-dominated vegetation and cycle of having to reburn it. In addition, Turetsky et al. (2011) reported that interactions between peatland drainage and fire are likely to cause long-term carbon emissions to far exceed rates of carbon uptake, diminishing the northern peatland carbon sink. Therefore, burning technique should be impeded and zero burning method should be implemented widely in peatland preparation to avoid changing of peatland function.

Cost of peatland preparation

The three methods of peatland preparation practiced at the research site require different cost. Cost of each method was calculated based on number of labor needed, and production means applied using the present price in Indonesian Rupiah (IDR) (Table 3).

Table 2. Peatland preparation methods are done by respondent, especially in establishing area for plant cultivation at the research site (Murniati et al. 2018, modified)

Land preparation methods	Number of respondents	Percentage (%)□
Under control burning	13	32.5
Zero burning, manually	16	40
Zero burning, mechanically (use heavy machine: excavator)	2	5
Under control burning and zero burning (manually)	6	15
No data available	3	7.5

Table 3. Average cost of peatland preparation according to method used at the research site

Peatland preparation method	Average cost (IDR/ha)			Total cost	Practised by
	Peatland preparation Labor	Herbicide	Additional cost*		
Under control burning (n=13)	1,465,000	-	-	1,465,000	Poor farmers
Zero burning, manually (n=16)	2,030,000	320,000	1,000,000	3,350,000	Middle farmers
Zero burning, mechanically (n=2)	5,500,000	-	1,000,000	6,500,000	Rich farmers

*Note: Cost for production means (agriculture lime and fertilizer)

The average cost needed to prepare agriculture peatland through under control burning method is IDR 1,465,000,- per ha or about US\$ 110.09 (1US\$ \approx 13,307 IDR). The cost was spent to pay labor wage for cutting down and slashing small trees, clearing the shrub, stacking all biomass on the certain strip lines, and burning the dry biomass. The average cost for land preparation using zero burning method and manually was IDR 3,350,000,-per ha or about US\$ 251.75. It covers labor wage in order to cut down and slashed the small trees and stumps, buying and applying herbicide and clearing the land as well as buying agriculture lime and fertilizers. Application of zero burning method by using heavy machine (excavator) requires highest cost, i.e. IDR 6,500,000,-per ha or about US\$ 488.46, mainly to pay excavator rent and wage of the operator as well as buying agriculture lime and fertilizers. As shown in Table 3, actual cost of zero burning is significantly higher or more than two times than that of burning method (in this case it is under control burning). SIIA (2017) concluded that improving peatland management practices is not simply about reducing negative impacts, but also improving the livelihoods of millions of small-scale farmers. Such farmers generate barely enough income to survive, with the additional costs and difficulties of planting on peatland, having a major limiting factor. Therefore, in order to promote zero burning farming practice, various incentive schemes should be offered for the peatland farmers.

Data on Table 3 indicated that margin of cost in preparing agriculture peatland between zero burning (manually) and under control burning was IDR 1,885,000,- or about US\$ 141.65. This cost margin is recommended to be used as standard for incentive that should be provided for poor farmers who are willing to practice zero burning of peatland preparation as a compensation. The incentive is recommended to be realized in the form of empowerment program, and it will be discussed in Chapter III.E.

Some strengths and weaknesses of zero burning peatland preparation

There are some studies mentioning several benefits by practicing zero burning instead of burning in agriculture peatland preparation. Some strengths and weaknesses of zero burning technique in peatland preparation will be elaborated below.

Strengths of zero burning peatland preparation

Many studies suggest that zero burning has been capable of reducing greenhouse gas emissions, especially

for CO₂ (ASEAN 2003). By applying mechanical clearing instead of burning in land preparation, could prevent carbon release as well as dissolved carbon particles (Chantuma et al. 2012). Indonesia's peatland stores a huge amount of carbon up to 60 billion metric tons, which makes it a virtual carbon bomb. Globally, the amount of carbon held in tropical peat is around 88.6 billion metric tons. If all this carbon were released into the atmosphere as carbon dioxide it would be the same as burning all proven oil reserves from Saudi Arabia, Venezuela, Canada, Russia, and the United States (Talocci, 2014). Forest fires across Indonesia have caused a smoky haze to shroud the neighboring countries like Singapore and Malaysia prompting safety fears over pollution. In 2013, the haze index is very high in Singapore and Malaysia which is under the category 'hazardous and unhealthy' for the first time in the country's history (Palanissamy, 2013). Peat fires and the release of carbon from peat and forests in Indonesia is the third largest greenhouse gas emitting country, after the US and China. Subsequently, research done in Singapore, Malaysia and northern part of Indonesia (Riau Province) about greenhouse gas emissions from the fires using measurements on the ground combined with satellite observations concluded that more than 884 million tons of carbon dioxide was emitted in the region during 2015, with 97 per cent originating from forest fires in Indonesia. Thus, the regional carbon dioxide emissions from the fires were 11.3 million tons per day in September and October 2015, more than the 28-nation EU's daily emissions of 8.9 million tons during the same period (The Straitstimes 2016). Moore et al (2013) reported that total fluvial organic carbon flux from disturbed peat swamp forest caused by deforestation, drainage and fire, is about 50 per cent larger than that from intact peat swamp forest.

Prior to zero burning policy has been widely campaigned, many studies had revealed that the burning ash can increase the availability of soil nutrients rapidly (Juo and Manu 1996). Research from Murniati et al. (2018) also confirmed that the burning ash increase phosphor (P) availability of peat soil. However, only within a short period, a number of these nutrients will quickly disappear through erosion and run off or leaching. Although erosion and run off in peatland nearly zero, the nutrient could loss through leaching using drainage that usually be made to support plant cultivation. Subsequently, Wong (2016) argued that mechanical technique applied in land preparation which is done by compressing peat into a smaller volume using mechanical equipment instead of burning technique could decrease the size of the pore

spaces within the peat soil reducing the amount of oxygen in the peat soil and hence the flammability of peatland. Furthermore, zero burning during land preparation could also restore nutrients through the decomposition of residual plant biomass (stumps and residual harvest), although nutrients returned are not as fast as if it is returned by burning ash (Simorangkir 2007). Therefore, applying zero burning technique during land preparation will not bring negative impact on the growth of the plant (Kheong 2011).

From biological aspects, land burning will directly reduce the population of soil microorganisms rapidly, as a result of temperature increase around burning area, whereas the indirect effect of burning is the long-term change in the environment affecting the biological life of the soil which is very harmful for the biological diversity (Verma and Jayakumar 2012). This argument is in line with the study from Adeniyi (2010) who reported that the number of soil microorganisms on burning forest land decline and begin to increase on the 42nd day after burning, but the population has not been able to match the unburned land. Preventing the use of fire during land preparation would considerably avoid the decline of soil microorganism population.

Weaknesses of zero burning peat land preparation

In spite of supports for zero burning land preparation, it also has some weaknesses in its application.

Related with economic consideration, Simorangkir (2007) argued that for large-scale land clearing when applied to high-volume vegetation, zero burning remains more expensive compared to burning due to difficulties in disposing of high-volumes of wood mechanically. Therefore, in commercial plantations, this land preparation technique is considered impractical, since it takes time and number of tractor works hours more than that of land preparation with burning.

However, apart from several regulations upon burning activities during peatland preparation used in Malaysia and Indonesia, it is still plagued by risk of large-scale burning on those areas due to rapid growth in agricultural sector, other changes in land use activities and lack of enforcement. Additionally, the over-generalized forest protection provisions enacted in 1984 National Forestry Act are found to have gaps that need amendment in Malaysia and also in Indonesia (Kamaruddin et al. 2017).

From the above description, despite some advantages and disadvantages of zero burning practices and considering the very high burning risk, zero burning technique is a much safer in the peatland preparation. However, in its implementation, it requires actual support from related stakeholders especially to provide incentive/reward for those who are willing to practice zero burning as well as compensation of cost increase in peatland preparation. Furthermore, intensive socialization about zero burning practice should be given to all parties who concern with sustainable peatland management.

Incentive needed for zero burning peatland farming system and its alternative scheme

The interference of government and related stakeholders in the implementation of a program such as

sustainable land use campaign can have a positive impact on the success of its implementation (Girling and Bauch 2017). Similarly, the support of government and relevant stakeholders for the community groups are also required to encourage the wide implementation of zero burning peatland preparation. The support provided is an incentive for their willingness to practice the program being developed. □

A study carried out in Pelalawan, Indragiri Hulu and Indragiri Hilir, Riau Province by Rohadi (2017) revealed that it is difficult for the farmers to follow the Government's zero-burning policy on peatland. As a result, a number of landowners decided to leave their farms as their harvest could not compensate the high production cost for land preparation. In this situation, the abandoned lands create a higher risk of wild fires during the dry season due to the build-up of biomass from the bush. To resolve the problem, Rohadi (2017) suggested that there should be a flexible approach in the implementation of zero-burning policy on peatland so as not to harm small farmers in the long run. Genuine farmers should be allowed to implement controlled land burning. Traditional community wisdom makes it possible to apply the technique with the guidance of government officials in the field. Furthermore, as compensation from the farmers' efforts in applying zero-burning in land preparation, adequate incentives should be provided. Agustira and Ranola (2014) also stated that there is a need to provide incentives for smallholders farmers in implementation of sustainable oil palm plantations on peatland since the current situation of the plantations in Siak District, Riau Province is leads to greater social cost than social benefit.

Actually, incentives are key to attracting and maintaining participation in community based natural resource management initiatives. Giles et al (2014) argued that financial incentive interventions was significantly effective for encouraging community behaviour change as expected. Incentives which is meant to modify behavior can in some cases be cost effective (Gneezy et al. 2011). However, incentives can not work at people do not know about them, if they are inappropriate or if they are delivered in insuffisien quantity (Suich 2012).

Incentives/disincentives are not merely rewards or punishments, but it related with positive or negative changes in outcomes that will be produced from an action which is done by certain rules both in the physical and in social contexts (Ostrom et al. 1994). Incentives will effectively influence outcomes when it is applied in an established institution and conducive environment. In its implementation, Government and related stakeholders can play a big role to initiate incentive scheme. But, would the Government be ready and commit to create enabling environment for providing such incentives for the community?

There is various incentive scheme might be applied such as subsidies and soft loans, agricultural means, livestock or tree seedlings and various training facilities for capacity building. However, many studies confirm that economic incentives produced larger and persistent effects, which induced habit formation after the final interventions (Ito et al. 2018). One example of incentive provided by

Wetland International for participatory restoration and conservation of mangrove in Pesantren Village, Pemalang District, Central Java Province was bio-right scheme (Suharti 2017). The incentive scheme is implemented through funding mechanisms as one strategy to accommodate efforts to increase economic benefits of mangrove resources and to prevent counterproductive activities to the environment through restoration and conservation actions (Eijk and Kumar 2008). Through bio-rights scheme, besides gaining financial benefits, villagers also received other benefits such as improvement of environmental conditions, e.g., widespread mangrove plantation and improvement in land productivity. □

In developing zero burning technique campaign, the use of excavator in peatland preparation is costly. Hence it is difficult to apply within an incentive scheme. Therefore, there is a need for an alternative technology that can be utilized for peatland preparation and the answer for this is by providing lightweight land processing tools at affordable prices. Lightweight peatland processing tools can be obtained through modification of the transplanter machine into a hijacking machine, and its price ranges from 20 to 40 million rupiah per unit (Sinaga PH 2015: personal communication). If in one village it can be provided as many as 10 units with a cost of 200 to 400 million rupiahs, it will be sufficient to be utilized interchangeably by farmers. Subsequently, because it involves a lot of costs, the support from related stakeholders to facilitate incentive scheme development for zero burning techniques tremendously needed. □

Furthermore, incentive scheme for zero burning practice should be in the form of beneficial programs enabling farmers to prepare unburn farming. This is in accordance with several complains revealed by farmers (especially middle-low farmers) who have difficulties in processing their peatland without burning. They need technical guidance and assistance as well as provision of equipment and production facilities. The program should be implemented gradually, starting with the preparation or precondition of the community (peatland farmers) through

socialization and raising awareness of the community to prepare land without burning. Further training and technical guidance, supply of peatland processing equipment, subsidized production facilities, especially agricultural lime (dolomite) and NPK fertilizer should be provided for the community.

Potential stakeholders involved in incentive implementation □

Identification of stakeholders for incentive schemes implementation

Stakeholders are individuals, or groups, or institutions that may be affected by the execution of an activity/ program, whether positive or negative, or otherwise affecting the outcomes of an activity/program (Reed et al. 2009). Each stakeholder has different interests, needs and perspectives and should be well managed, so that the targets to be achieved can be realized (Shandas and Messer 2008; Sandra 2009; Rajablu et al. 2014). Stakeholder analysis is an essential part of stakeholder management (Jepsen and Eskerod 2009). In turn, stakeholder engagement in a new program/project activities includes communicating with, involving and developing relationships among the stakeholders (Chinyio and Akintoye 2008; Missonier and Fedida 2014).

Stakeholders related to the implementation of incentive schemes to prepare zero burning peatland preparation should be identified in order to know: (i) the interests and influence of related stakeholders; (ii) local institutions and its institutional strengthening efforts; and (iii) community participation model that needs to be prepared. On the basis of field observations and interviews with a number of key informants, there are 16 institutions related with the implementation of incentive schemes for unburn peatland farming. Subsequently, series of in-depth interviews involving 32 respondents had been conducted in order to attain detailed description about them and their prospect of involvement in the incentive scheme implementation (Table 4).

Table 4. Institution and number of respondents interviewed for their prospect of involvement in incentive scheme implementation

Name of Institution	Number of respondents
Forestry Service of Riau Province (Dishut Prov)	4
Center for Natural Resource Conservation of Riau (BBKSDA Riau)	1
Forestry and Estate Crops Service of Siak District (DishutbunKab)	3
Regional Development Planning Board of Siak District (BAPPEDA)	2
Agriculture Service for Food Crop and Horticulture of Siak District (Distan Pangan & Horti)	2
Implementing Agency for Extension and Food Security of Siak District (BP2KP)	2
Environment Agency of Siak District (BLH)	3
Cooperatives, Industry and Trade Service of Siak District (Diskoperindag)	2
Agency for Community Empowerment and Village Government of Siak District (BPMPD)	1
Riau University (UNRI)	1
Forest Management Unit of Tasik Besar Serkap (KPH)	2
Timber Plantation Company of Arara Abadi (TPCAA)	1
Institute for Agricultural Technology Assessment of Riau Province (BPTP Riau)	2
Community Forestry Communication Forum of Riau Province (FKKM Riau)	2
Village Government (Pemdes)	3
Joint Farmer Groups (Gapoktan)	1
Total	32

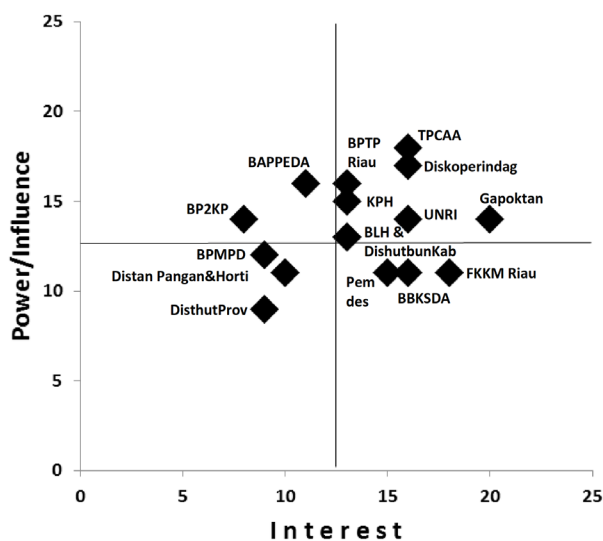


Figure 3. Result of stakeholders mapping in the implementation of incentive scheme for unburn peatland preparation

Analysis of prospect for stakeholder involvement in incentive schemes

Stakeholder analysis is conducted by interpreting matrix of stakeholder's interest and influences/power on the implementation of incentive schemes by using grid stakeholders with the help of Microsoft excel. Scoring results on the importance and influence/power of each stakeholder are clustered according to its indicator and then mapped on the x-axis (interests) and the y-axis (influence) to form the coordinates. By classifying the level of influence/power and interest into two, i.e., low and high, it will form four quadrants. Position of quadrant could describe level of influence/power and interest of each stakeholder. Those four quadrants are: (i) Quadrant I: Stakeholders with high level of power/influence and low level of interest. (ii) Quadrant II: Stakeholders with high level of both power/influence and interest. (iii) Quadrant III: Stakeholders with low level of power/influence and high level of interest. (iv) Quadrant IV: Stakeholders with low level of both power/influence and interest.

The result of stakeholder mapping based on the power and interest scores is shown in Figure 3. It can be seen from Figure 3, that stakeholders with low interest but high powers are BAPPEDA and BP2KP of Siak District. These two stakeholders according to Reed et al. (2009) are classified as Context setters (Quadrant I). Stakeholders with high interest and influence (power) are classified as Key Players (Quadrant II). Key Players can be interpreted as a major player in the implementation of incentive schemes. These institutions have great authority to facilitate the implementation of incentive scheme and issuing rules related to it. Stakeholders classified as key players in this study were Environment Agency of Siak District (BLH), Forestry and Estate Crops Service (DishutbunKab), Forest Management Unit of Tasik Besar Serkap (KPH), Institute for Agricultural Technology

Assessment of Riau Province (BPTP Riau), Riau University (UNRI), Cooperatives, Industry and Trade Service of Siak District (Diskoperindag), Private company (TPCAA) and Joint farmer groups (Gapoktan). Generally, universities have high interests, but their influence is low. However, in this case, both indicators are equally high. It might be because the university is very much involved in the process of transferring science and technology to the parties concerned, hence it could directly influence others in making decision-related with incentive schemes for unburn peatland preparation. Stakeholders in Quadrant II have great importance and authority, due to some factors, i.e., (i) having human resources concerning with unburn peatland, (ii) retaining high mobility, and (iii) capability of instigating incentive schemes. □

Stakeholders with high interest but low power/influence are classified as Subjects (Quadrant III). Subjects can be interpreted as an organization concerning with activities of unburn peatland preparation although they do not have the authority to influence or formulate regulations. Stakeholders with "subjects" characteristics have low capacity in achieving objectives, but they can be influential by forming alliances with other stakeholders (Reed et al. 2009). Stakeholders belonging to the "subjects" are Center for Natural Resource Conservation of Riau (BBKSDA Riau), Community Forestry Communication Forum of Riau Province (FKKM Riau) and Village Government (Pemdes). Although, having low power/influence, in implementing a new program/regulation, stakeholders with "subject" characteristics should be well informed.

Subsequently, stakeholders with low interest and low power (Quadrant IV) are classified as Crowd. Stakeholder engagement in a new program/regulation is generally under-considered because interests and power/influences tend to change over time (Reed et al. 2009). Stakeholders classified as "crowds" in this study were Forestry Service of Riau Province (Dishut Prov), Agency for Community Empowerment and Village Government of Siak District (BPMPD) and Agriculture Service for Food Crop and Horticulture of Siak District (Distan Pangan & Horti).

Result from stakeholder analysis has indicated that there are a lot of stakeholders having enough power and interest to initiate and implement incentive scheme in zero burning peatland technique like Environment Agency of Siak District (BLH), Forestry and Estate Crops Service (DishutbunKab), Forest Management Unit of Tasik Besar Serkap (KPH), Institute for Agricultural Technology Assessment of Riau Province (BPTP Riau), Riau University (UNRI), Cooperatives, Industry and Trade Service of Siak District (Diskoperindag), Private Company (TPCAA) and Joint farmer groups (Gapoktan). However, since incentive scheme will be related closely to funding issue, there is a need of synergic coordination and cooperation among related stakeholders. This is meant to ensure that the allotment of roles and responsibilities among related stakeholders in the implementation of incentive schemes could be carried out properly. □

In conclusion, although since 2014 the Indonesian government has strictly banned the use of fire to clear peatland areas for agriculture to tackle the ongoing disaster

of fires and haze that menace human health and the environment, some respondents (especially middle-low farmers) still use under control burning technique in peatland preparation. Main consideration underlying it is due to actual cost of zero burning which is significantly higher or more than two times than that of burning method (in this case it is under control burning). Therefore, as compensation for the farmers' efforts in applying zero burning in land preparation, adequate incentives should be provided especially for the middle-low farmer. Cost margin between burning and zero burning technique of peatland preparation should be used as a standard for the incentive. The incentive scheme for certain peatland farmers should be in the form of programs enabling them to prepare zero burning farming. The program should be implemented gradually, starting with the preparation or precondition of the farmers, training and technical guidance, supply lightweight peatland processing tools and subsidized production means, especially agricultural lime, and NPK fertilizer. Implementation of the incentive scheme to support zero burning peatland preparation should be initiated immediately through establishment of demonstration plot (*demonstration activities*) at village level. Potential stakeholders involved and their commitment to implement the incentive scheme should be encouraged, especially commitment from BAPPEDA of Siak District to allocate funding for stakeholders who concern with zero burning peatland preparation. □

ACKNOWLEDGEMENTS

The authors thank the Siak District Government, Riau Province, Indonesia for permission in conducting the study, especially Forestry and Estate Crops Services Office and the staff for accompanying the field survey. Special thanks Sumarhani for her help in field data collection. Our appreciation and thanks go to related stakeholders for their support and participation in providing necessary data and information and to the peatland farmers in Tuah Indrapura, Sungai Mempura, Mengkapan and Dayun Villages for their cooperation during field observation and series of interview. This work was supported by Centre for Forest Research and Development, Ministry of Environment and Forestry. □

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