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Peatland Fire Mitigation: Indigenous People's Way in Surviving Economic and Ecological Sustainability

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Abstract

Peatland fires in Indonesia have generated significant losses economically and environmentally but mitigation efforts to decrease these effects have been limited. This study aims to analyze the types of fire catastrophe mitigation carried out by neighborhood agencies and pick out the constraints of land fireplace mitigation. This lookup is qualitative learning with in-depth interviews with fire care neighborhood groups, firefighting corps and landowners in areas regularly affected by the fires in South Kalimantan, Indonesia. The consequences confirmed that the neighborhood and landowners had been dedicated to defending peatland from fires. The area extinguished flames by way of the usage of boreholes and firefighting facilities.

Landowners commit to preserving their productive agricultural land; however, they overlook the unmanaged or deserted property. Mitigation is minimal due to a shortage of water sources and technological know-how limitations, which regularly failed to overcome peatland fires. Utilizing deserted land inclined to hearth into productive land is beneficial for preserving land from burning to keep monetary and ecological sustainability.

Keywords: Community, mitigation, fires, peatlands, ecology, economic.

Introduction

Land fires in Indonesia have caused economic and ecological losses. The worst fires since 1997 occurred in 2015 and 36% occurred on peatlands¹. Although the area of peatland burnt is narrow, their impact was more significant than fires on mineral land². Peatland fires in Indonesia are repeated fires³. In Indonesia, forested tropical peatlands are converted to agricultural land or degraded to non-forest vegetation prone to fire⁴. Land clearing using fire contributes to land fires in Indonesia³.

Fire has long been used in traditional agriculture in Indonesia for a long time; only fires are increasingly widespread now.

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Starting from 1997-to 1998, peatland fires in Indonesia became an increasingly widespread environmental problem⁵. Economic factors are the leading cause of peatland fires⁶. The burning of peatlands has led to land degradation⁷. Most of the causes of fires in Indonesia are intentional factors in the context of land clearing.

Mitigation of increasingly widespread peatland fires needs to be done. Peat fire management is very effective for maintaining low peat C stock shortly and should be a high priority for climate mitigation efforts⁸. In their agricultural systems, climate change mitigation actions undertaken by farmers related to land preparation, water management and land management can reduce land fires. Activities that can be taken to mitigate peatland fires are building canal blocking systems, introducing water and soil management technologies, revitalizing agricultural extension agencies and building fire extinguishers and increasing farmers' experience and knowledge about climate change⁹.

Understanding the overall impact of fires on climate change can also support the mitigation of peatland fires¹⁰. The effort to prevent fire is by knowing the location of the hotspot, the mechanism of the fire spreading and the leading cause of the land fire¹¹.

Peatland fire mitigation can be done through restoration activities, namely re-wetting, re-vegetation and revitalization of community livelihoods^{12,13}. Mitigation by rewetting is by rehabilitating the hydrology of peat to natural conditions including blocking canals, refilling canals and building deep wells¹³. Firefighting and hydrological restoration are practical efforts to reduce emissions from land fires⁸. Another restoration activity is re-vegetation. Re-vegetation is an effort to restore land cover in peat ecosystems by planting native plant species in protected functions or with different types of plants adaptive to wetlands and having economic value in the cultivation function.

Re-vegetation techniques were carried out with a surjan and plasticulture system¹⁴. Revitalization of community livelihoods aims to improve the welfare of communities in and around the peat restoration area. The revitalization program encourages integrated farming systems on peatlands where the surjan and plasticulture systems are the main choices¹⁴.

Data on forest and land fires in the territory of Indonesia shows that during the 2014-2019 period, forests and land in the region of Indonesia occurred with the most extensive fires in 2015 and 2019. In 2015 there were forest fires and an area of 2,611,411.44 Ha, while in 2019, there was a fire in 1,592,010.00 Ha. Forests and land in South Kalimantan that experienced fires in 2015 were 196,516.77 Ha while in 2019, it was 136,428.00 Ha. The forest and land fire area are high compared to other provinces in Indonesia.

The fire in Banjarbaru in South Kalimantan becomes an actual problem because of the potential vital object of Syamsudin Noor International Airport. Land fires disrupted flights at the airport. On September 18, 2019, there were seven delays in flight departure due to haze and due to land fires. Visibility on that date was only 300 meters at 06.00 am and previously at 05.25 am it was 500 meters visibility¹⁵. Banjarbaru is also the center of the government of South Kalimantan Province, so fire prevention has become very important¹⁶.

Mitigation by involving the community is an effort to overcome land fires in the Banjarbaru region. Community participation is vital in reducing the risk of land fires. Communities can reduce and prevent land fires in their area. Community empowerment in strengthening social capital can become an internal force and increasingly plays a role in planning and implementing disaster risk reduction independently. The fire care community (*MPA*) is an efficient step in strengthening social capital in overcoming

peatland fires. This study aims to analyze the causes of land fires in the study area, analyzes the forms of fire disaster mitigation carried out by community groups and analyzes the community constraints in implementing land fire mitigation.

Material and Methods

Study Sites: This research was conducted in Banjarbaru, South Kalimantan Province, Indonesia. Peatlands in Banjarbaru always experience fires every year, especially during the dry season, so fire mitigation in this region is essential. The fire in Banjarbaru becomes a necessary problem because of Syamsudin Noor International Airport¹⁷⁻¹⁹. The research location of Banjarbaru is presented in figure 1.

Data collection: Data were obtained through field observations and depth interviews from December 2019 to March 2020. Respondents in this study were members of the fire care group community or Masyarakat Peduli Api (*MPA*) in Guntung Payung Village, as many as 20 people, *MPA* in Syamsudin Noor Village many as 15 people and landowners in the area where fires often occur as many as 14 people. The total of respondents is 49 people. According to the *MPA* members, interviews were conducted with a limited number directly involved in land fire mitigation activities. Interviews were performed using the Indonesian language, then recorded using a tape recorder. Questions are open and respondents answer questions more freely.

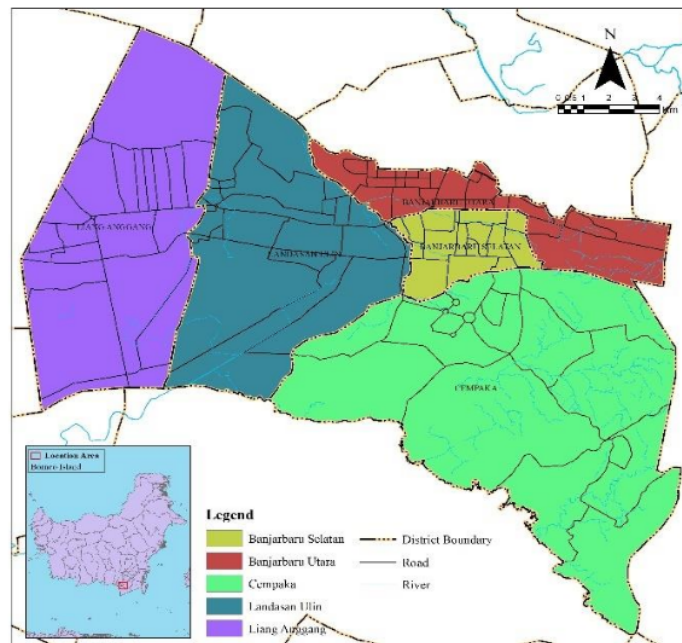


Fig. 1: Study sites of Banjarbaru

The research also uses documents from The Peatland Restoration Team of South Kalimantan Province or *Tim Restorasi Gambut Daerah (TRGD of South Kalimantan)*. The document includes the number of drilled wells in the Banjarbaru region. This research also uses the Focus Group Discussion (FGD). We collect data about fire management carried out by *MPA* and local governments.

FGD is organized by the researcher and TRGD of South Kalimantan with 48 participants from the member of TRGD of South Kalimantan, *MPA* in Guntung Payung Village and *MPA* in Syamsudin Noor Village, heads of Guntung Payung Village and heads of Syamsudin Noor Village, Banjarbaru Environmental Agency, Environmental Agency of South Kalimantan Province, Regional Disaster Management Agency of South Kalimantan Province or *Badan Penanggulangan Bencana Daerah (BPBD)*, Forestry Agency of South Kalimantan Province, *Angkasa Pura Company (Airport Company)*, on July 30, 2019 and August 8, 2019. The discussion was on the rapid wetting of burning peatlands and fire-prone peatlands in 2019. FGD was also held on July 17, 2020, with participants from *MPA* Guntung Payung village with 20 participants.

Data Analysis: To obtain data validation in this study, a crosscheck was made between the results of observation, interviews and documentation. Data analysis uses triangulation techniques (data reduction, data display and data verification)²⁰.

Interview results are reduced according to the focus of the study. The results from the reduction are then described to get the study results. The data obtained in the field are also verified by secondary data obtained from literature reviews and information from TRGD. Verification of literature data in qualitative research is carried out together with proof of data findings in the field.

Results and Discussion

Factors causing a fire in peatlands: Factors causing a fire in the peatland area include natural and human factors. Biological factors are caused by high temperatures and strong wind on the dry side. The nature of peatlands can store large amounts of water, but the surface is dry and flammable during the dry season, causing fires to expand²¹. The human factor is caused by human activities in preparing the land to be used for agriculture or deliberately throwing cigarette butts into dry land.

The community agreed that the human factor is the highest causing land fires. The fires in Indonesian territory are driven more by human behavior²². People who want to clear land generally burn before the land is used because burning is the cheapest way; as the respondent said, the fire's leading cause is humans, especially when they want to clear land.

The land most affected by fires is abandoned land and is not processed into agricultural land. Communities who prepare

the ground for agriculture can still relatively protect the land from fires that are getting wider. In contrast, abandoned land does not prevent and protect the land from burning.

Burning land is a factor causing land fires in Banjarbaru. The community prepares land for agriculture by burning land. The research conducted by Arisanty et al^{4,5} also explains that burning is a method widely used in converting peatlands for plantations. The community claims land burning increases soil fertility^{24,25}. The fact is that burning land causes land losses. Damage due to land burning turns out to be greater because peatlands will experience degradation.

Agricultural activities are claimed to cause the fire, but people who burn land for agriculture keep fires from spreading. They will put out the fire immediately after they prepare the ground. However, burning land to prepare agricultural land is not the best solution for land preparation. The people in Indonesia in the wetlands have known an environmentally friendly farming system such as the Banjar Tribe (a tribe in South Kalimantan Province).

Traditionally peatland farming consists of *tabas* (cutting the grass), *puntal* (rolling the grass), *Balik* (flipping the grass) and *ampar* (spreading the grass) systems. This system illustrates the principle of conservation in wetland areas without burning land²⁶. They want to cultivate their land quickly and at a low cost so that the traditional value is abandoned.

Land that was abandoned and did not become agricultural land turned out to be a land that was more at risk of fire than productive land for agriculture. The dry season is when intense fires occur because dry peatlands are easier to burn²³. Shrubs that dry out during the dry season make the land very potential and prone to burning. Communities are less able to control land fires on land that is not theirs or land that they do not manage, so the land has a higher risk of fire. Communities are better at controlling their agricultural land so that fires do not become more widespread. Success in environmental management activities cannot ignore the values and perspectives in society²⁷. Natural resources can be used to sustain people's lives so that they will protect the environment²⁸. Indigenous peoples' knowledge has proven effective in fire management. Customary land managed by communities has been shown to have the lowest incidence of forest fires²⁹.

Forms of community-based mitigation: The community uses the wellbore for rewetting their land and reducing the land fire. The artesian well is their wellbore to water their agricultural land (Figure 2).

Drill wells also exist with assistance from the government and non-government agencies. Another form of mitigation is Government regulation. The Government announces through signposts or banners related to the ban on land burning carried out by the Government.

The MPA and landowner consider that the prohibition in signposts and banners banning land burning is less effective. Many people do not care if only with a form of appeal. The MPA and landowner stated that it would be most effective if more wells were drilled and that the wellbore was located close to the agricultural land. The community only reads the appeal from the banner but does not necessarily implement it because it does not have a direct impact on their activities.

Meanwhile, the procurement of drilled wells will directly affect them. Drilled wells can be used to irrigate agricultural land and, at the same time, extinguish fires when fires occur. Another way is to provide abandoned land to be managed by the community so that people are responsible when a fire occurs.



Fig. 2: Drilling Well Located on Agricultural Land

The existence of bore wells can be used as a re-wetting when no fire occurs and can be used for extinguishing when a fire occurs. Drilling wells on community land are used routinely in rainy and dry seasons not to block the well. Drilling wells on community land are used to water agricultural land and be used for rewetting during the dry season. The wellbore's weakness, which is mainly built in this area, is the location far from the settlement so that no one controls the condition of the well.

In addition to agricultural activities, land fires can be overcome using boreholes. Wetting activities can be done through the construction of functional boreholes. The community uses the wellbore in their farmland to wet the land. Drilling wells on agricultural land will be more helpful in preventing fire on peatlands than drilling wells far from

settlements and agricultural land. The well has a certain depth in the mineral soil layer so that in the dry season, it still functions as wetting or tackling peat fires³⁰. Hydrological management also reduces land subsidence and CO₂ emissions^{31,32}.

The form of mitigation is carried out by the community before a fire occurs by protecting the land, especially the land they manage. People have an economic interest in the ground because the land is their source of livelihood. The community is very concerned about keeping the land from burning further. They have bore wells that will be used when there is a fire. Burning the land to prepare the ground was carried out to ensure that the fires did not spread. Economic re-vitalization by utilizing land that is prone to burning to land productive turns out to be far more effective in reducing land fires in this region than merely calling for a ban on burning land (Figure 3).



Fig. 3: Peatlands Managed by Communities

Disaster mitigation from other communities is to participate when a fire occurs. MPA carried out disaster preparedness activities in Guntung Payung Village and Syamsudin Noor Village. MPA activities are needed when occurring fires, but they also control areas prone to fire during the dry season. Membership MPA comes from the community. The MPA's control activities are very helpful in preventing fires in locations prone to land fires. Information from this MPA will soon be disseminated to prevent fires from spreading. MPA contains and controls fires when a fire occurs. The form of land fire mitigation is presented in table 1.

Table 1
Forms of land fire mitigation

| S.N. | Form of mitigation | Benefits for Community |
|------|--|--|
| 1 | Use of unused land for productive agriculture | Increasing community income and reducing uncontrolled burning of land |
| 2 | Socialization to the community not to burn land by involving MPA | Increased knowledge and awareness for the community not to burn the land |
| 3 | Construction of bore wells on community land | Drilling wells help wet agricultural and dry land and as a water source to extinguish fires. |

Table 2
The problem and effort to reduce Peatland Fire Based Community

| S.N. | Problem | Effort |
|------|--|--|
| 1 | Limited fire fighting equipment | Addition of fire fighting equipment through government funds and community funds |
| 2 | A limited number of drilled wells | Addition of drilled wells through government funds and public funds |
| 3 | A limited number of MPA members | Recruitment of <i>MPA</i> members from the community |
| 4 | Limited <i>MPA</i> firefighting skills | <i>MPA</i> capacity training by local governments |

Constraints in mitigation: Constraints in mitigation are the lack of tools to extinguish such as pumping machines and pipes. The devices come from non-governmental organizations, but the numbers are not many because of the limited costs. MPA also got the equipment provided by the South Kalimantan Province Government in machine pumping and vehicles, but the amount was also limited. Another obstacle is the wellbore condition, primarily those far from residential areas; too many are not functioning. Small wellbore discharges in damaged situations cause difficulties in obtaining water when a fire breaks out. The limited number of MPA members also becomes an obstacle in putting out fires when fires occur. Firefighting training activities for members of the MPA have also been done by the *BPBD* of South Kalimantan Province.

MPA and the landowners also need to drill wells at several points prone to fire. Difficulties in getting water and distant water sources also become obstacles in the field when land fires occur. Non-government organizations in locations of fire-prone donate 50 drill wells. The location of bore wells in the Syamsudin Noor Village was 20 units, but only four teams were functioning and 16 teams were not functioning. Drilling wells in Guntung Payung Village were 30 units, 14 units were functional and 16 units were non-functional. The borehole is not working well because of the minimal water discharge during the dry season. The wellbore was built far from the settlement's communities, so it was difficult to reach when there was a fire.

Drilling wells now from payments are rarely or never used to become clogged and not functioning. Poorly functioning drill wells cannot be used for fire prevention through peatland wetting. Drilling wells cannot be used when there is a fire, so it is difficult to extinguish them. Damaged drill wells can hamper peatland wetting processes to prevent peatland fires.

The lack of facilities and infrastructure for handling land fires owned by the community requires attention from the local government. Local governments can increase the number of fire-fighting equipments such as machine pumping and vehicle. Apart from government funds, equipment purchases can also be obtained from non-governmental funds. Communities whose land is often burnt, can work together to collect funds from community funds, so they do not have to wait for assistance from the

local government. The problem and effort to reduce peatland fire-based community are presented in table 2.

Community groups members of the MPA manage land fires at the study site. Community and institutional activities in preventing peatland fires are still lacking. The current institutional and regulatory framework focuses on land fire emergency response³³. Despite this, the existence of a community concerned about the fire has participated in community-based forest and land fire prevention initiatives. More than 200 villages covering at least 1.5 million ha of land in Indonesia join in community-based forest fire prevention initiatives³⁴. MPA is directed at controlling fire, not only as a fire extinguisher. Local community knowledge of drought and land fires has potential value in the context of developing community-based early warning systems for land fire prevention³⁵.

People who are members of the MPA still understand that fire management is how to put out fires. Fire management should be a matter of mitigation in the event of a fire or firefighting and how to manage the fire. Effective fire management can be realized with the involvement of stakeholders to thoroughly explore various land and fire management options³⁶. One of them is utilizing the Getis-Ord G_i^* analysis (hot spot analysis) and kernel density analysis, which can analyze the spatial pattern of land fires in South Kalimantan. The spatiotemporal pattern and fire density can help determine the priority in handling land fires²³.

Conclusion

Community participation in peatland fire mitigation is beneficial and necessary. Community economic empowerment in areas prone to land fires is more effective in dealing with land fires. Communities are more responsible for the land they manage than land abandoned without management. Providing fire-fighting facilities and bore wells to the community on managed land were more beneficial for fire prevention than existing bore wells far from settlements. Prohibition of land burning proved to be less effective in preventing land fires if only a ban without the direct involvement of the community through community economic activities is put.

This study recommends the use of neglected land as productive agricultural land with the community as land

managers to be further improved to mitigate land fires while increasing the community's welfare. Utilization of borewells with the community as users of bore wells can be done on fire-prone land so that the wellbore continues to function both in the framework of prevention and for extinguishing the fire during a fire.

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