MODULE 3

COMMUNITY-BASED PEATLAND FIRE PREVENTION AND CONTROL

In collaboration with

Measurable Action on Haze-Free Sustainable Land Management in Southeast Asia (MAHFSA) Programme

Content

1. **INTRODUCTION**

1.1. **Benefits of Peatland**

Peat is a type of wetland that is formed by piles of organic materials such as remains of trees, grass, moss and decayed animal corpse buried in the soil. The Ministry of Environment and Forestry (KLHK) in its Ministerial Regulation (Permen) No. 7 of 2006 stated that peatland is soil resulting from the accumulation of organic matter through biomass production in tropical rain forest.

Indonesia has the largest peatland area among the tropical countries, i.e. around 21 million hectares distributed in the islands of Sumatra, Kalimantan and Papua (BB Litbang SDLP, 2008). This means Indonesia has the largest peatland in southeast Asia with 88% of total peatland area in the region, followed by Malaysia with a total of 2.56 million ha, Brunei Darussalam 90.9 thousand ha, Thailand 64.5 thousand ha, Vietnam 24 thousand ha, Philippines 20.2 thousand ha, Myanmar 11.2 thousand ha, and Cambodia 9.8 thousand ha (asean.org, 2020).

Benefits of Peatland

Protecting the environment from climate change

Out of the vast land area worldwide, only 3% is peatlands. However, this relatively small area of land has a high ability to absorb carbon. In fact, the land is able to absorb as much as 550 gigatonnes of carbon or about 30% of the carbon that is in the soil around the world. Meanwhile, peatlands in Indonesia can store up to 57 gigatonnes of carbon or approximately 20 times more than what other types of forests and soil can store. That is why peat forest management must be very careful. This is because draining one hectare of peat forest in the tropics can emit 55 metric tons of carbon dioxide every year, or the equivalent of burning more than 6 thousand gallons of gasoline.

Reducing the adverse effects of floods and droughts

Peat forest has a very high absorption capacity, even being able to hold water up to 450 to 850 percent of its dry weight or approximately 90% of its volume. Not only that, peat soil that has been decomposed is able to hold water between 2 to 6 times its dry weight. Because of this ability, peat is of great benefit in reducing the adverse effects of floods and droughts. It is able to hold water in very large quantities so as to prevent flooding during the rainy season, and release it during the dry season

Support the economy

Various types of plants with high economic value can grow well on peat soils. In fact, peat soil is a natural habitat for some of these plants. Some of these include rattan, rubber, pineapple, thatch, sugar cane, sago, coconut, and others. Besides being good for various types of plants, this land is also very suitable to be managed as a breeding ground for various types of fish. Some of them are Siamese catfish, tilapia, and African catfish. Because

of these rich benefits, peat areas can be managed to support the economy of the people in the vicinity. Good management will increase people's livelihoods so that their economic sustainability is also maintained.

Natural habitat of various biodiversity

Various types of animals and plants live and breed in peat areas. Some of them have great benefits for the community and the environment, therefore maintaining their sustainability is very important. Several types of animals that live in peat areas and have endangered status are orangutans (Pongo spp.), red langurs (Presbytis rubicunda), Bornean clouded leopards (Neofelis diardi borneensis), swamp forest herons (Ciconia stormi), and white-winged geese (Asarcornis scutulata). In addition, Sinyulong crocodiles, Sumatran tigers, sun bears and tapirs can also be found in peatlands. Several types of plants that we can find in peatlands include *pulai*, jelutung, durian, *sundi* sap, guava, geronggang, Sulawesi black wood, and nutmeg. Meanwhile, the most common plant found in the peat forests of Kalimantan and parts of Sumatra is ramin, a type of luxurious wood that is usually used for making furniture.

1.2. **Impact of Peatland Fires**

Peatland fires began to be widely discussed since 1997 when land was cleared for the One Million Hectare Peatland Project in Central Kalimantan. Based on data from BAPPENAS-ADB in 1999, it is estimated that peat forest fires that occurred in Indonesia in 1997/1998 reached 2.1 million hectares spread across Sumatra, Kalimantan and Papua. fires on peatlands occurred repeatedly, although on a not too large scale, until the massive peatland fires occurred in 2015. The fires that occurred in 2015 burned 194,787.88 hectares of peatlands.

With the occurrence of severe fires on peatlands in 2015, the Indonesian government then began to focus on restoring and protecting Indonesia's peat forests by issuing Government Regulation no. 57 of 2016 concerning Protection and Management of Peat Ecosystems and establishing a Peat Restoration Agency. However, even after the establishment of the Peat Restoration Agency, large peat fires still occurred in 2019. Peat fires in 2019 burned an area of 711,927.30 hectares of land and caused haze that spread to neighboring countries.

Peatland fires cause damage to the ecological function of peat which threatens the loss of biodiversity in burnt areas, the impact of the 1997 forest and land fires is estimated to have resulted in respiratory tract infections in 20 million people and the consequences of the 2015 fires are estimated to have resulted in respiratory infections in around 500 thousand people, the haze has also resulted in increased cases of premature death and traffic accidents due to limited visibility.

Greenhouse gas emissions resulting from forest and land fires in 2015 are estimated at 1.6 million tonnes of CO2 or more than the United States' total daily greenhouse gas emissions. These greenhouse gas emissions will contribute to accelerating the rate of global warming. Estimated losses to the state generated by forest and land fires in 2015 amounted to 16

billion USD or equivalent to 1.8% of Gross Domestic Product and losses due to forest and land fires in 2019 amounted to 5.2 billion USD. Economic losses caused by fires on peatlands include losses in agriculture, forestry, transportation, trade, industry, tourism and other sectors.

Forest and peatland fires are mainly caused by land clearing by burning for agricultural land and plantations. The burning is deliberately done so that the land is clean and the ashes from the fires become soil fertilizer so that the land is ready for planting. This activity is usually carried out during the dry season because it is still considered easy and cheap by farmers who have minimal land clearing capital for agriculture and plantations.

2. SOCIALIZATION ON MAPPING OF FIRE-PRONE AREAS

2.1. Socialization on prevention of land and forest fires

Socialization on fire prevention is carried out by involving interested parties in the event of forest and land fires. This socialization can be carried out from various administrative levels of the target area. Socialization is carried out by presenting information regarding efforts to prevent and control fires. From this socialization it is also hoped that the parties can be actively involved from planning, implementing and monitoring in efforts to prevent and control forest and land fires.

2.2. Participatory Mapping of Administrative Areas and Fire-prone Areas

Administrative area mapping is carried out to find out the governance of village areas based on information from village communities which is poured in the form of spatial data, administrative areas are important to know so that people know their managed areas and know their village development plans.

Administrative area mapping carried out in Harapan Jaya Village through the following stages:

1. Collect information on village history from old people in the village
2. Before carrying out data collection in the field, the community is trained to understand basic knowledge related to mapping both theoretically and field application in taking coordinate points for maps
3. The mapping activity is discussed with the surrounding village area
4. A participatory map made containing information on village boundaries, agricultural areas, public facilities and village hydrological pathways

After the participatory Administration Map has been completed, then do a GIS analysis to see the history of fires that have occurred in the last 5 years in the village area. Then hold

discussions with the community to verify the occurrence of fires in their area. Some of the information we collect include:

1. The community collects a matrix of fire incidents over the last 5 years containing information on time/incident, location/place, estimated area of burnt area, initial source of fire and countermeasures
2. Community information is then overlaid with hotspot data for the last 5 years
3. The resulting map is a fire-prone area which will be a priority for monitoring during the dry season

3. FOREST AND LAND FIRE CONTROL STRATEGY

3.1. Prevention at the Community Level

3.1.1. Fire Information System Approach

An information system about possible opportunities for a fire to occur that is well distributed to relevant stakeholders down to the field level is one component of the success of fire prevention measures. Conventionally this information system is carried out by direct monitoring in the field (fire-prone locations), the use of maps and compasses and the use of kentongan in villages as a tool to inform the community about the possibility of a fire. Currently, with the help of modern technology (computers, telecommunications equipment, the internet, remote sensing (geographical information systems)) a fire information system can be developed based on factors that influence the occurrence of fires such as fuel conditions, climatological conditions and fire behavior.

1. Types of Fire Information Systems

Several systems have been developed to warn of the possibility of a fire, including:

a. Early Warning System

The early warning system was developed using daily weather data as a basis for calculating the drought index. This drought index describes the level/value of soil and land moisture deficiency. Sources of daily weather data can be obtained from BMKG (Meteorology, Climatology and Geophysics Agency) which can be accessed on the website https://www.bmkg.go.id/ and if the area coverage does not meet then it is necessary to establish several weather stations to measure rainfall, temperature, humidity and wind speed periodically. so that data on rainfall, temperature, air humidity and wind speed are available in certain management areas (eg peatland areas)

b. Fire Hazard Warning System

The Fire Danger Rating System is used to monitor the possibility of fires occurring at both the central and regional (Provincial and District) levels, especially in terms of prevention and

suppression efforts. The Fire Danger Rating System is one of the early warning systems regarding the possibility of a fire occurring or not. This system was developed based on indicators that affect the occurrence of fires, namely fuel moisture and dryness level. So that through this FDRS we can find out about fire hazards, fuel moisture conditions and drought levels that occur in an area.

Fire Weather Index

Fire Hazard is a general indication of all the factors that affect the ease of occurrence of fire, the spread of fire and the physical impact of fire, as well as the degree of difficulty of controlling fire. The Fire Hazard Classes are developed from the Fire Weather Index values.

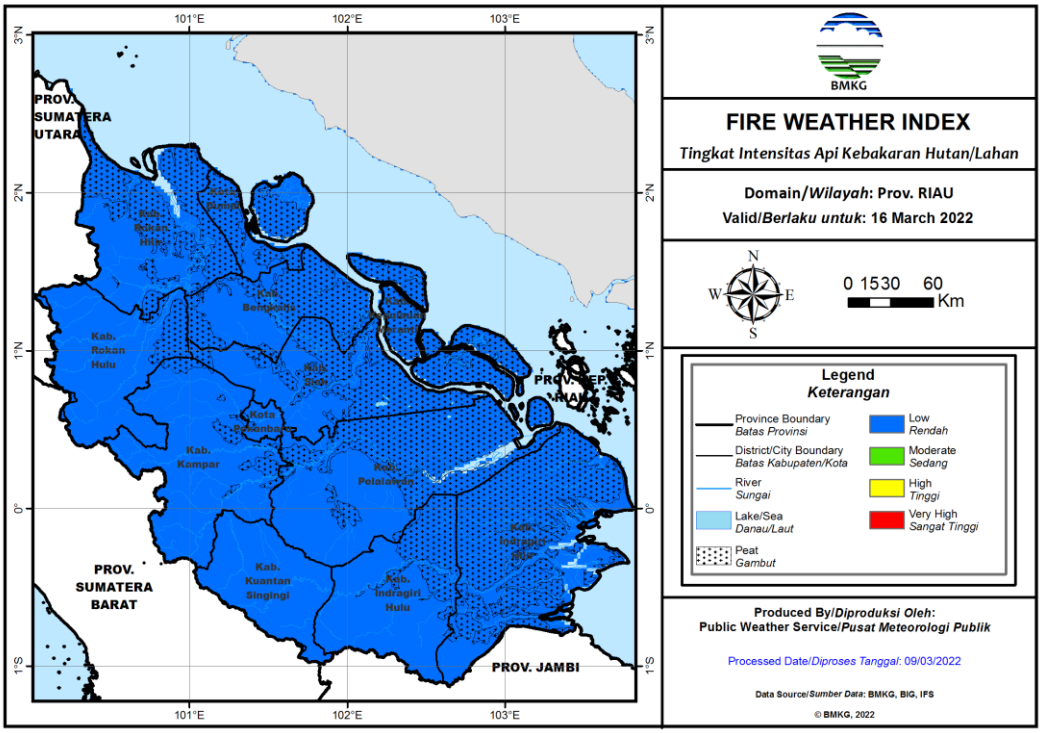

Figure 1. Fire Weather Index on bmgk.go.id

FWI shows the magnitude of the fire intensity if a forest fire occurs, strongly influenced by ISI and BUI values

Color	Range	Description
Blue	0 - 1	Low fire intensity. Fires are easy to control, tend to go out on their own.
Green	2 - 6	Medium fire intensity. The fire is still relatively easy to control.

Color	Range	Description
Yellow	7 - 13	High fire intensity. Fire is difficult to control.
Red	>13	Very high fire intensity. Fire is very difficult to control.

Fine Fuel Moisture Code (FFMC)

FFMC is a numerical rating of the moisture content of litter and other fine fuels. This code indicates the relative ease of starting a fire and burning fuel. This code is closely related to human-caused fire incidents.

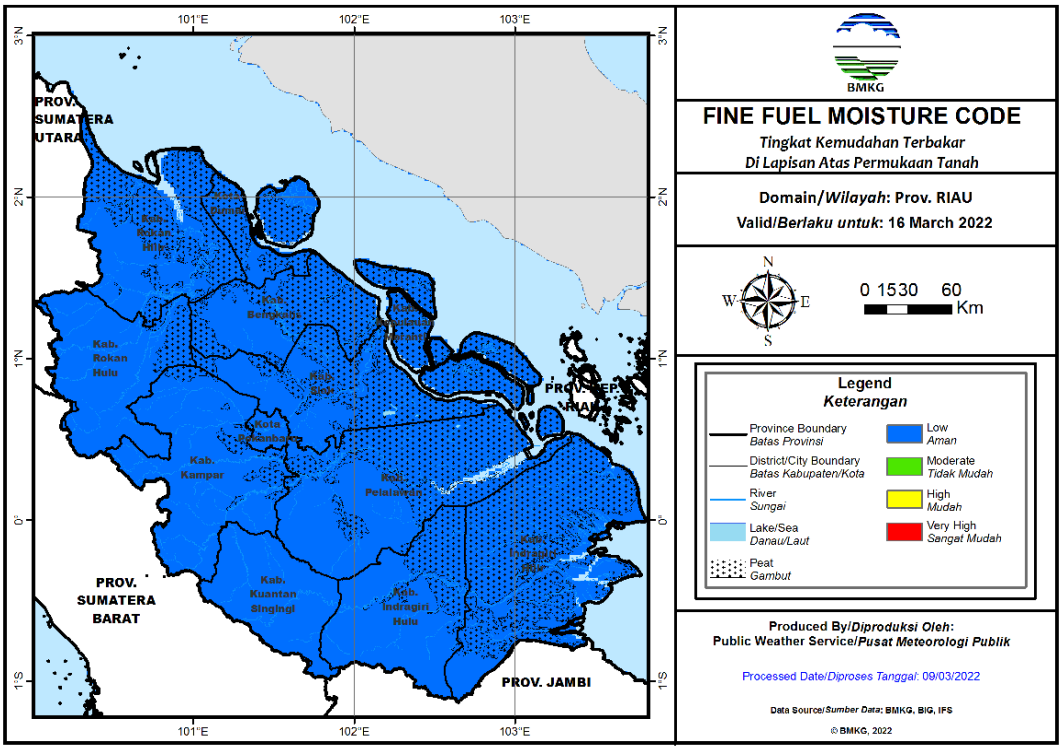

Figure 2. FFMC Map of Riau Region (bmkg.go.id)

FFMC shows the level of potential for easy fire occurrence in terms of weather parameters on combustible materials in the topsoil layer. Represents the dryness level of light combustible materials (such as surface humus, dry leaf litter, reeds, and other light materials) that normally cover the forest floor at a depth of 1-2 cm.

Color	Range	Description

Color	Range	Description
Blue	0 - 72	The reeds and leaves that usually cover the forest floor are wet and **difficult** to burn
Green	73 - 77	The reeds and leaves that usually cover the forest floor are moist and **quite difficult** to catch fire
Yellow	78 - 82	The reeds and leaves that usually cover the forest floor are dry and **easily burn**
Red	>82	The reeds and leaves that usually cover the forest floor are very dry and **highly flammable**

Drought Code (DC)

DC indicates the level of potential for easy fire occurrence in terms of weather parameters on solid organic matter in the subsurface and heavy wood materials (such as logs) on the soil surface. Represents the dryness of dense organic soil layers which are usually >10 cm deep and also represents the dryness of heavy woody materials (such as logs) at the soil surface.

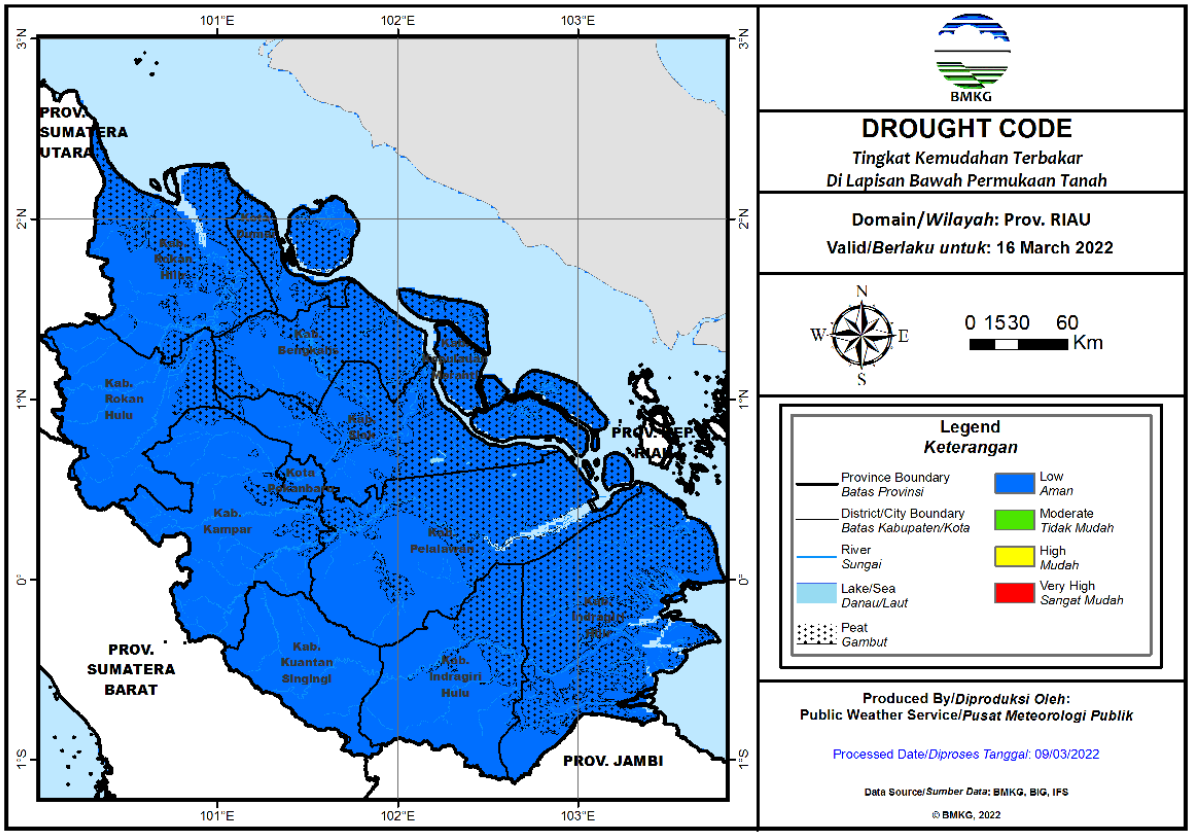

Figure 3. Drought Code Map of Riau Province

Color	Range	Description
Blue	0 - 140	The condition of the lower surface layer of soil is **wet**. It can take more than 4 weeks without rain to reach very dry conditions.
Green	141 - 260	The condition of the lower surface layer of soil is **moist**. It will take at least 2 weeks without rain for it to reach very dry conditions.
Yellow	261 - 350	The condition of the lower surface layer of the soil is **dry**. Drought is starting to occur, supervision of land burning activities needs to be stricter. If in the next 5-7 days there is no rain, it could increase to a very dry category.
Red	>350	The condition of the lower surface layer of the soil is **very dry**. Drought is starting to reach extreme conditions, a ban

Color	Range	Description
		on burning land needs to be enforced. *) Based on historical records, very severe haze conditions in Indonesia occur within this value range.

c. Hotspot Monitoring System

The rainfall factor and its anomalies are the most important indicators for triggering fires in Indonesia (Syaufina et al., 2004; Ceccato et al., 2010). Another indicator that is very commonly used is the detection of hot spots from remote sensing satellites. Hot spots (hotspots) are indicators of forest fires that detect a location that has a relatively higher temperature compared to the surrounding temperature (Permenhut Number P.12/Menhut-II/2009). Satellites that are known to detect hotspots are the NOAA Satellite, Terra/Aqua MODIS, as well as remote sensing satellite data.

Another definition, a hotspot is the result of detecting forest/land fires at a certain pixel size (eg 1 km x 1 km) which may catch fire when the satellite passes in relatively cloud-free conditions using a certain algorithm (Giglio L. et al. 2003). Hotspots are usually used as indicators or forest and land fires in an area, so the more hotspots, the more potential for land fires to occur in an area. Although not always the more and more hotspots in an area, the greater the potential for fire incidents. However, hotspots can indeed be used to identify forest and land fires early.

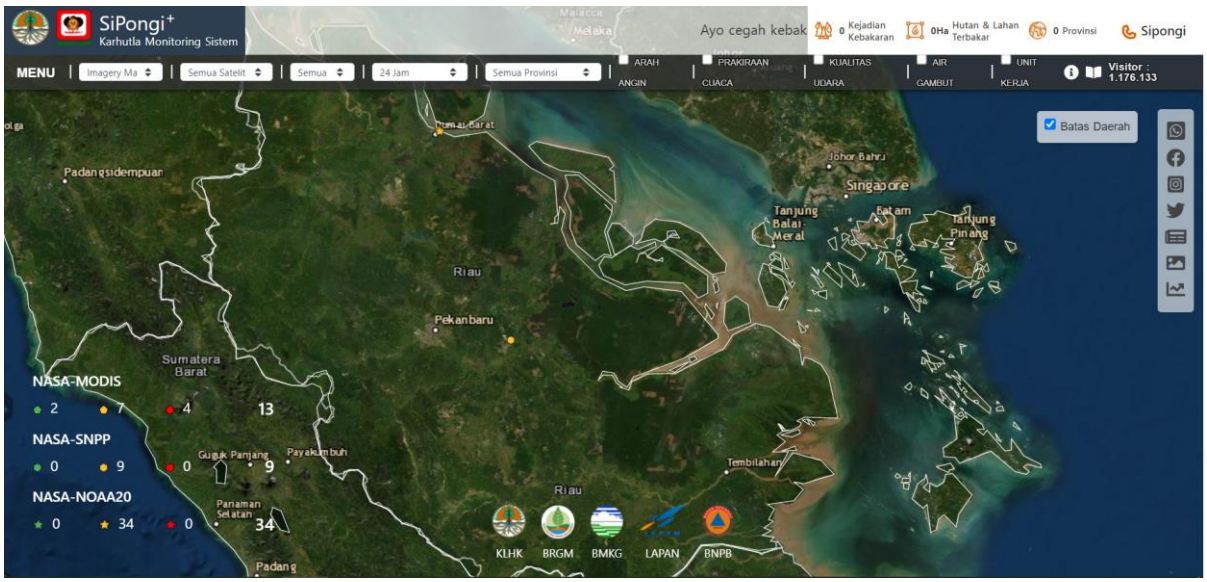

Figure 4. Display of Hot Spots on the Sipongi MenLHK Website (https://sipongi.menlhk.go.id/)

3.1.2. Community Participation Approach

Increased participation/participation of local communities in forest and land fire prevention is influenced by several factors, namely encouragement and stimulation, incentives, opportunities, abilities, and guidance. Efforts to increase community participation can be done through:

- Campaigns to increase public awareness of the dangers of fire and law enforcement through direct dialogue and/or through educational media (storybooks, stickers, brochures, calendars, posters, etc.)

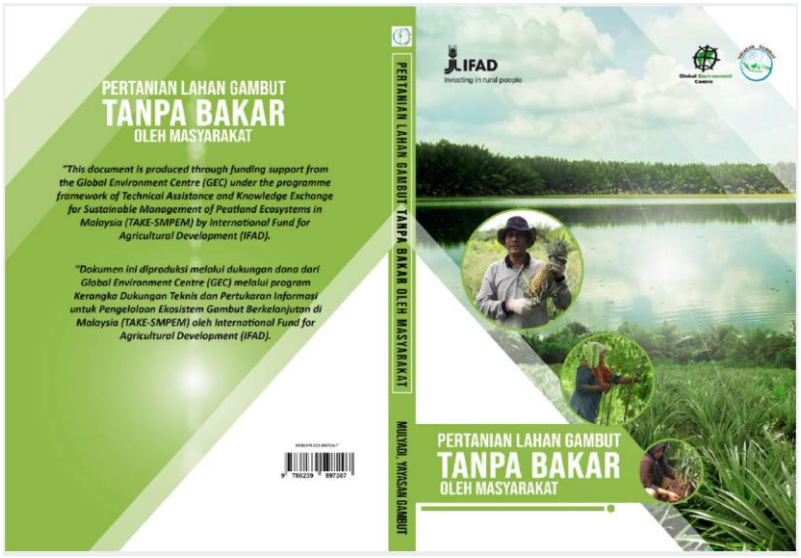

Figure 5. Book on Land Agriculture without Burning (source: yayasangambut.org)

- Providing incentives, so that the community will benefit from their active participation in preventing and controlling fires. Incentives can be given in the form of developing alternative products that can be produced by the community such as rattan handicrafts as well as in developing environmentally friendly economic activities.

Figure 6. Demonstration plot of No-Burning in Temiang Village, Bengkalis, Riau

- Community capacity building through training and mentoring
- Formation of a Fire Brigade Team at the community level in Riau Province in the form of the Fire Care Society (MPA) which functions to help tackle forest and land fires from an early age in the village administration area. This team was formed from members of the community, with the village head as the person in charge, while the relevant NGOs and fire control agencies acted as directors and mentors.

3.2. **Planning for Peat Land Wetting Infrastructure**

The fire-prone areas that have been mapped are then overlaid with existing canals, for dry canals then plans are made for wetting the peat through the construction of infrastructure such as canal blocking, canal backfilling, drilled wells and other techniques according to technological developments. With this wetting, it is hoped that the hydrologically disturbed peat will experience restoration/improvement and the peat will remain wet and moist so that the rate of degradation and the potential for peat fires can be prevented/reduced.

Peat rewetting is expected to provide benefits in the short, medium and long term in the form of:

1. Reducing the risk of fires on peat land and forests
2. Reduced rate of decline/subsidence of peat soil (Land Subsidence)
3. Reducing the rate of greenhouse gas emissions (greenhouse gases emissions)

4. The hydrological function of peatlands and
5. Accelerating the peat restoration process

In an effort to re-wet peatlands, there are several infrastructures that are usually carried out by the community, including the construction of canal blockings, embankment of canals and drilled wells.

1. Canal Blocking

Canal blocking is one of the efforts that needs to be made to increase the water holding capacity of peatlands, by constructing canal blocks that can reduce the outflow rate and maintain or increase the body of the canal, the condition of the peatland is wet, peatland will be difficult to burn.

The criteria and types of drainage canals that need to be made of canal blocks include the following:

1. The blocked canal is an artificial drainage canal (not a natural river or creek)
2. Downstream of the artificial drainage canal network is connected directly to natural drainage, such as rivers, creeks and lakes and downstream leading to discharge into the sea
3. Priority for blocked canals are areas that are prone to drought due to artificial drainage
4. Blocked canals do not interfere with community transportation activities and can be modified so that community activities are not disturbed.

2. Canal Filling

Canal backfilling is a peat wetting technique in which the open drainage canals in a peat ecosystem are backfilled or filled back with soil (peat) and/or local organic matter (rotted stems, branches and wood debris, etc.) so that the canals experience siltation and sedimentation thereby reducing the drainability of water flowing out through the canal body and retaining water in peatlands (Houterman & Ritzema, 2009; Applegate et al, 2012; Dohong, 2016).

The main objective of canal filling activities is water conservation through the process of increasing sedimentation of artificial drainage canals and reducing run off from peat dome areas and/or conservation/protected areas so that the water level and water holding capacity in these areas remain high, especially during dry season.

The location for canal filling activities is recommended in areas with a conservation/ protection function.

1. The filled canal is a built drainage canal located in a conservation/protected area
2. The outlets of the network of artificial drainage canals are connected/directly connected to natural drainage, such as rivers, creeks, lakes and seas.
3. Priority canals that are filled up are areas that are prone to drought (due to the presence of canals) and prone to fires; And
4. The network of artificial drainage canals is not used as a navigation route by the community.

3. Drilled well

Drilled wells are facilities and tools in the form of pipes or serial connections of PVC pipes that are installed/planted into peat soil to drain/remove water sources located in the underground layer of peat (aquifer layer).

The purpose of constructing drilled wells is to overcome the scarcity of surface water sources which generally occurs during the dry season. Under these conditions, generally the water table in peat drops drastically and the natural surface water sources found in canals/gullies, creeks, rivers and lakes experience drought and reach very far away. The drilled well can be used by the community as a source of water for early fire suppression.

Location criteria for drilled well construction activities include the following:

1. The location of the planned placement of the drilled well is in a priority location prone to fire
2. Areas where there is a potential scarcity of natural surface water sources and are far from natural water sources (streams, rivers, lakes and seas), especially during the dry season;
3. Areas that have limited direct access either by land (roads, bridges) or water (rivers, lakes, canals/ditch); and Areas with underground water sources (aquifer layers).

3.3. **Planning of Funding Sources**

Planning for budget sources related to forest and land fire control can be allocated using village funds, referring to Permen LHK No. 32 of 2016 concerning Forest and Lhaan Fire Control, Article 1). Efforts to prevent forest and land fires are carried out at the village community level in three ways, namely: (i) budget planning; (ii) routine patrols in areas prone to forest and land fires with the parties; and (iii) implementation of physical prevention in the field by self-management with the community. Meanwhile, the people who live around the company can partner with nearby companies regarding funding for routine patrols in efforts to prevent fires.

3.4. **Patrol Planning**

Patrol planning can be arranged by community groups, including by determining patrol routes, the patrol team is usually two people, and the implementation schedule is carried out every day during the dry season, as well as reporting mechanisms. Sepahat Village, which is in Bandar Laksamana Subdistrict, Bengkalis Regency, during the dry season routinely conducts patrols in areas prone to fires. In patrolling activities, people who carry out agricultural activities are also advised to be careful of the potential for fires to occur in their area.

The following is the form used for patrol reports:

1. Form to Report Land and Forest Fire Incident

Incident Number	Location of Fire (Village, Land tenure)	Area (Ha)	Source of Fire/Cause of Fire	Fire Condition (Big/Small)	Potential Loss
1					
2					
Control measures taken: Documentation of fire incident:					

Note :

- Incident numbers are sequenced from number 1 onwards (the following day's incident number continue from the previous day's fire incident number);
- Administrative area is the name of the village, district/city and province;
- The control measures taken are in the form of an explanation of the actions taken, such as blackouts, requests for assistance, coordination with related parties, etc.;
- For fire incidents that last more than one day, progress must be reported every day until the fire is declared extinguished, by writing down the number of the initial fire incident (for example: fire incident number 5, if still burning the next day, write down as the fire incident number 5)

2. Form for forest and land fire prevention patrols

Date	Time (how many hours)	Patrol area	Peat Water Surface Conditions	Findings During Patrol	Name of Patrol Officer

Notes:

- The team in charge of filling out the patrol schedule starts at what time and ends at what time
- In what hamlet or on whose land is the patrol conducted?

- Findings during patrols whether there are people fishing in the canals, or burning activities to clear land that has the potential for fires

3.5. **Land and Forest Fire Suppression**

Fire suppression at the village level is carried out as early as possible before the fire spreads because if the fire has penetrated a very deep layer of peat, only nature can do it effectively, namely heavy rain. Efforts to extinguish the fire by humans, apart from requiring a lot of money and effort, also do not necessarily extinguish the fire completely.

Rapid suppression actions should be taken if land and forest fire occurs by mobilizing human resources at the village level and related parties, identification and mapping of water sources, financial support, supporting facilities and infrastructure.

Figure 7. Fire suppression by the community at Rokan Hilir Regency, Riau

Forest and land fire incidents that occurred in the village were reported by the village head verbally to Manggala Agni, the Operational Area Closest to the Village where the fire occurred, and reported to the Head of Police and Babinsa (Bintara Pembina Desa).

Supporting Facilities and Infrastructure

The implementation of fire prevention activities must be supported by adequate facilities and infrastructure, including:

- Road Network
- Fire Tower

- Communication tool
- Binoculars and Compass
- Means of transportation
- Extinguishing devices such as: fire bats, axes, rakes, shovels and back pumps
- Equipment for the Fire Team (Fire retardant clothes, boat shoes, helmets, gloves, flashlights and drinking bowls)

Table 1. One set of equipment to extinguish forest and peatland fires for a team of 15 people

No	Equipment	Quantity
1	High pressure fire pump	2 units
2	1,5 Inch Fire Hose	10 rolls (20 Meter/Roll)
3	1 Inch Fire Hose	4 rolls (50 Meterl/Roll)
4	Fog Jet surface fire	2 pcs
5	Fog Jet deep fire	2 pcs
6	Divider clutch	2 pcs
7	1000 liter water bag	1 pc
8	Rake hoe	2 pcs
9	Hoe	2 pcs
10	Axe	2 pcs
11	Machete	4 pcs
12	Handsaw	1 pc
13	Jufa Backpack Pump 15 liter	3 pcs
14	Handy Transcelver (HT)	3 pcs
15	Bucket	2 pcs