GHG REDUCTION PROJECT THROUGH FOREST PRESERVATION IN PEAT LAND IN CENTRAL KALIMANTAN

“Guidebook for a Community-Based Fire Prevention and Control System for Tropical Forests and Peatland in Central Kalimantan Province, Indonesia“
# Table of Contents

Document Prepared for: .................................................................................................................................................................................. 1

1. Introduction ........................................................................................................................................................................................... 4

1.1 Background ......................................................................................................................................................................................... 4

1.2 The need for a community-based integrated forest and peatland fire prevention and control system .................................................................................................................................................................................. 4

1.3 Contribute to GHG emission reductions .................................................................................................................................................................................. 5

1.4 Policy .................................................................................................................................................................................................................. 8

1.4.1 Legal basis ......................................................................................................................................................................................... 8

1.4.2 Indigenous and positive law enforcement ........................................................................................................................................... 8

1.5 Objectives and target audience of this guidebook .................................................................................................................................................................. 9

1.5.1 Objectives ........................................................................................................................................................................................................... 9

1.5.2 Target audience ........................................................................................................................................................................................................... 9

2. Basic knowledge about forest and peatland fires ........................................................................................................................................................................ 10

2.1 Causes and enabling factors of forest and peatland fires .............................................................................................................. 10

2.1.1 Causes of forest and peatland fires .................................................................................................................................................................. 10

2.1.2 Enabling factors on forest and peatland fires .................................................................................................................................................................. 10

2.2 Types of forest and peatland fires ...................................................................................................................................................... 11

2.3 Impact of forest and peatland fires .......................................................................................................................................................... 13

2.3.1 Ecological impacts ................................................................................................................................................................................. 13

2.3.2 Human health impacts .............................................................................................................................................................................. 14

2.3.3 Social and economic impacts ............................................................................................................................................................. 15

2.4 Efforts to minimize forest and peatland fires .................................................................................................................................................... 15

2.4.1 Controlled burning (on mineral soils) ................................................................................................................................................... 15

2.4.2 Zero burning land management on peatland ........................................................................................................................................ 16

2.4.3 Protection and maintenance of community farms and plantations ................................................................................................. 17

3. Community-based fire prevention and control systems for tropical forests and peatland ........................................................................................................... 18

3.1 Preparation and information dissemination (socialization) ........................................................................................................... 19

3.1.1 Preparation and information dissemination procedure ......................................................................................................................... 19

3.1.2 Establishment of firefighting teams (RSA) .................................................................................................................................................. 19

3.1.3 Firebreaks ........................................................................................................................................................................................................ 23

3.2 Fire prevention strategy ........................................................................................................................................................................... 25

3.2.1 Early detection of fires ........................................................................................................................................................................ 25

3.2.2 Fire prevention procedures .................................................................................................................................................................. 27

3.3 Fire suppression strategy ........................................................................................................................................................................... 28

3.3.1 Early fire suppression procedures ..................................................................................................................................................... 28

3.3.2 Fire suppression techniques ................................................................................................................................................................. 28

3.4 Post fire strategy ......................................................................................................................................................................................................... 32

3.5 Equipment and infrastructure ......................................................................................................................................................... 33

3.5.1 Deep water well .................................................................................................................................................................................................. 33

3.5.2 Fire post ........................................................................................................................................................................................................ 38

3.5.3 Transportation ......................................................................................................................................................................................... 39

3.5.4 Fire suppression equipment .................................................................................................................................................................. 39

3.6 RSA monitoring plan ................................................................................................................................................................................................... 41
Endnotes
1. Introduction

1.1 Background

In Indonesia, forest and peatland fires occur during the dry season on an almost annual basis, burning vast areas of peatland and forests across the archipelago. When peat layers are dry, fires can burn roots and underground organic matter for up to months at a time, and spread below the surface very quickly. Not only do they pose an immediate threat to human health and wildlife, haze from the fires also disrupts transport and the economic activities of millions of people. Haze pollution often extends to neighboring countries such as Malaysia and Singapore, which leads to increased tensions with these governments. Furthermore, the burning of peatlands and forests is a major contributor to Indonesia’s greenhouse gas (GHG) emissions. Between 0.81 and 2.57 gigaton (Gt) of carbon dioxide (CO$_2$) were released into the atmosphere as a result of widespread forest and peatland fires in Kalimantan and Sumatra in 1997. This is equivalent to 13–40% of the mean annual global carbon emissions from fossil fuels.$^1$

Indonesia encompasses 136.17 million hectares (ha) of forest$^2$, of which 20 million ha are peatland$^3$ and about 3 million ha are located in Central Kalimantan Province. In the same province, forest and peatland fires have occurred almost annually for the last two decades. Efforts to suppress the fires continue, but due to the challenges of putting out fires on peatland, these efforts have become ineffective. Fires have destroyed farms, forests, land, and many other assets. However, people tend to think of forest fires as something that will happen regularly; so there haven’t been any pro-active efforts made to prevent them from happened again.

Therefore, it is important for people to understand more about these fires, what causes them to happen, and what their impacts are on human life. By understanding fires, people will have more awareness about the importance of preventing fires in the first place.

1.2 The need for a community-based integrated forest and peatland fire prevention and control system

The frequency and extent of peat and forest fire events in Indonesia implies that effective fire-prevention measures and early-control systems are not yet in place. This is partly attributed to the absence of village-level management bodies, which are tasked to prevent and mitigate devastating forest and peatland fires. Furthermore, peatland’s geographical conditions and characteristic terrain, coupled with the lack of access roads, often pose considerable challenges in conducting patrols and the early suppression of fires. Low awareness about the causes and impacts of peatland fires and the lack of coordination among local government authorities, business players and local communities also undermine efforts at proper land management.

Fires often spread out of control due to unclear land tenure (i.e., overlapping village boundaries and unrecorded land ownership), the absence of effective peatland and forest fire management systems, and a lack of community involvement in the handling of forest and peatland fires. Furthermore, there is a need for the government and private sector to be more involved in playing the important lead roles, especially in the prevention and extinguishment of these frequently occurring forest fires.

The suppression of underground fires is extremely difficult – once they spread, one can only put out the blaze by either pumping in thousands of liters of water or simply hoping for rain. Therefore, the priority must be given to the prevention and control of such fires before they spread. Local communities are the first to be affected by wild fires, and there is an increasing need for an integrated approach which is deeply embedded in the community setting to deal with peatland and
forest fires. Moreover, local people often become the most appropriate actors to manage or prevent fires at a local scale.

The successful integration of community-based fire prevention and control systems should contribute to:
- The decline in the number of fires and hotspots
- The decrease in the number of villages with forest and land fires
- A decline in the number of land arsonists
- Visibility is not affected
- The Air Pollutant Standard Index (PSI) value < 100
- A decline in the number of patients with respiratory diseases caused by pollution
- A decrease in greenhouse gas emissions

1.3 Contribute to GHG emission reductions

The protection of forests, especially in the tropics and sub-tropics, is an essential part of the international effort to reduce global GHG emissions and stabilize the global climate system. Previous research suggests that approximately 20% of global GHG emissions are attributed to the forestry sector. Given this background, reducing emissions from deforestation and forest degradation (REDD+) has gained momentum in global climate change dialogues, as it provides a framework to incentivize both public and private sectors to reduce GHG emissions, enhance carbon stocks and promote sustainable forest management in developing countries such as Indonesia.

The 26-41% GHG emission reduction commitment announced by President Susilo Bambang Yudhoyono in 2009 and abatement potentials of Indonesia’s land-use, land-use change and forestry and peatland sectors have triggered a number of multi-stakeholder initiatives and REDD+ financing outside the United Nations Framework Convention on Climate Change (UNFCCC) framework. These include private sector investment and bilateral cooperation programs between the Governments of Indonesia and developed countries.

One of the bilateral initiatives in the pipeline is the development of a REDD+ mechanism under the Joint Credit Mechanism (JCM) between the Governments of Indonesia and Japan. In order to establish a cooperation framework, the Japanese Ministry of Economy, Trade and Industry (METI) as well as the Ministry of the Environment (MOE) have been undertaking various feasibility studies on GHG emission reduction projects and accumulating experience and expertise from each case study. The Katingan Peatland Restoration and Conservation Project (Katingan Project), located on a tropical peat swamp forest in Central Kalimantan, Indonesia, has been one of the case studies used to develop REDD+ instruments under the JCM since 2010.

The following table presents the summary of estimated total net emission reduction amounts from the Katingan Project site for the period of 30 years.

**Net emission reductions from the Katingan Project site from year 1 to 30**

<table>
<thead>
<tr>
<th>Period</th>
<th>Emission (tCO₂/year)</th>
<th>Max-case drainage depth</th>
<th>Min-case drainage depth</th>
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<tr>
<td></td>
<td></td>
<td>(Drainage 0.95 m)</td>
<td>(Drainage 0.60 m)</td>
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<tr>
<td>Year 1</td>
<td></td>
<td>773,753.62</td>
<td>719,293.71</td>
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<tr>
<td>Period</td>
<td>Max-case drainage depth (Drainage 0.95 m)</td>
<td>Min-case drainage depth (Drainage 0.60 m)</td>
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<tr>
<td>--------</td>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td>921,573.37</td>
<td>812,653.55</td>
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<td>Year 3</td>
<td>1,069,393.11</td>
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<td>Year 4</td>
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<td>1,365,032.61</td>
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<td>Year 6</td>
<td>1,512,852.36</td>
<td>1,186,092.92</td>
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<td>Year 8</td>
<td>1,808,491.86</td>
<td>1,372,812.60</td>
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<td>Year 9</td>
<td>1,956,311.61</td>
<td>1,466,172.44</td>
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<td>2,104,131.35</td>
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<td>1,652,892.12</td>
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<td>Year 12</td>
<td>2,399,770.85</td>
<td>1,746,251.96</td>
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<td>Year 13</td>
<td>2,547,590.60</td>
<td>1,839,611.80</td>
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<td>Year 16</td>
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<td>Year 17</td>
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<td>Year 18</td>
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<td>Year 19</td>
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<td>Year 21</td>
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<td>Year 22</td>
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<td>Year 25</td>
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<td>Year 26</td>
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<td>3,053,289.74</td>
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<td>Year 27</td>
<td>4,617,067.08</td>
<td>3,146,649.58</td>
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<tr>
<td>Year 28</td>
<td>4,764,886.83</td>
<td>3,240,009.42</td>
<td></td>
</tr>
<tr>
<td>Period</td>
<td>Max-case drainage depth (Drainage 0.95 m)</td>
<td>Min-case drainage depth (Drainage 0.60 m)</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------</td>
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<tr>
<td>Year 29</td>
<td>4,912,706.57</td>
<td>3,333,369.26</td>
<td></td>
</tr>
<tr>
<td>Year 30</td>
<td>5,060,526.32</td>
<td>3,426,729.10</td>
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<td>Accumulated Total</td>
<td>87,514,199.11</td>
<td>62,190,342.20</td>
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</table>
1.4 Policy
1.4.1 Legal basis
The Indonesian forest legal framework regulates the use of land and the management of forests, and also addresses forest and peatland fires through relevant laws and regulations. They include:

a. Forestry Law No. 41/1999
b. Government Regulation No. 21/2001 on Damage Control and/or Environmental Pollution related to Forest and/or Land Fires. (State Gazette of the Republic of Indonesia year 2001, No. 10, Supplement to State Gazette of the Republic of Indonesia No. 4078)
c. Government Regulation No. 45/2004 on the Protection of Forests (State Gazette of the Republic of Indonesia year 2004 No. 147, Supplement to State Gazette of the Republic of Indonesia No. 4453)
d. Ministry of Forestry Regulation No. 12/2009 on Forest Fire Control
e. Ministry of Agriculture Regulation No. 14/Permentan/PL.110/2/2009 on Guidelines for Peatland Management for Oil Palm Cultivation
f. Law No. 32/2009 on Environmental Protection and Management (State Gazette of the Republic of Indonesia year 2009 No. 140, supplement to State Gazette of the Republic of Indonesia No. 5059)
g. Ministry of Environment Regulation No. 10/2010 on the Mechanism of Pollution Prevention and/or Environmental Damage related to Forest and/or Land Fires
h. Ministry of Agriculture Regulation No. 19/Permentan/OT.140/3/2011 on Guidelines for Indonesian Sustainable Palm Oil (ISPO)
i. Ministry of Agriculture Regulation No. 98/Permentan/OT.140/9/2013 on Guidelines for Plantation Business Licenses
j. Central Kalimantan Regional Regulation No. 5/2003 on Forest and Land Fires
k. Government Regulation No. 71/2014 on the Protection and Management of Peatland Ecosystems
l. Law No. 39/2014 on Plantation

1.4.2 Indigenous and positive law enforcement
Aside from positive laws, indigenous laws still play an important role in handling social matters including fires in Central Kalimantan. In order to address these issues, following recommendations should be considered.

a. Law enforcement should refer to indigenous laws, which is to be judged by the Head of Indigenous Communities. “Jipen” fines will be passed on those who are proven to cause a fire. The fine will be as much as the calculated amount of the loss of assets (e.g., plantation, agricultural field, or house).

b. If indigenous laws cannot be enforced, then positive laws should be enforced by the police, especially by the district police department.

c. Members of a village fire department can serve as expert witnesses at the Kademangan or positive law hearings.
1.5 Objectives and target audience of this guidebook

1.5.1 Objectives
This guidebook aims to give a basic knowledge about forest and peatland fires, and to provide a practical guide to community-based tropical forest and peatland fire prevention and control. It provides approaches for community-based control and prevention of fires, and their implementation and organization. Moreover, it explains how the early detection and monitoring of forest and peatland fires can be effected from their prevention to the extinguishment stage.

1.5.2 Target audience
This guidebook is intended to be used by communities as a reference to community-based fire prevention and control systems for tropical peatlands. In addition, it can be used by local governments and surrounding concessionaires as a facilitation tool to ensure community involvement in the control and prevention of fires on peatland.
2. Basic knowledge about forest and peatland fires

2.1 Causes and enabling factors of forest and peatland fires

2.1.1 Causes of forest and peatland fires

In Indonesia, fires rarely occur naturally. Natural factors such as lightning, the friction of dry biomass, or other natural phenomena are known not to have triggered any fires on peatlands because they are constantly inundated under natural conditions. Peatland fires generally occur due to human activities on degraded peatland where peat is drained and dry. Once ignited, during the dry season, fires can spread out of control and cause catastrophic damage. In Central Kalimantan Province, fires typically originate from the following activities:

a. Forest and land clearing through burning
   Fires are often used to clear forest and prepare land for agricultural or plantation areas. Known as slash-and-burn, it is an easy and cost-effective method, and the ash from the burning can be utilized as a fertilizer for the soil. This activity is typically practiced in the dry season, because there are no alternative methods which can be adopted by farmers and smallholders. However, if the burning is not controlled effectively, the wind could spread the fire over to surrounding areas, causing serious environmental damages and haze pollution.

b. The use of fire for livelihood activities
   Negligence in the use of fire for daily livelihood activities inside the forest area (e.g., when collecting non-timber forest products, clearing weeds for hunting, and making a fire for cooking) can cause a forest and peatland fire.

c. Tenurial claims
   Sometimes local people aim to claim their rights to unmanaged land by clearing and burning it as a way to prove that it has been managed by them. This is rather common around the city of Palangka Raya, Central Kalimantan.

2.1.2 Enabling factors on forest and peatland fires

Inundated and undisturbed tropical peatland forests are generally resistant to forest and peatland fires. During the wet season (with a high rate of rainfall), the land becomes bogged, soaking and causing even flammable materials to have such a high moisture content that they become difficult to burn. However, in the dry season is high, degraded forests and land can quickly become dry and prone to forest and peatland fires as dry peat and the plants are highly flammable. The vulnerability rate of forest and peatland fires in forests and peatland is influenced by several factors, i.e. the climate conditions, its physical condition, and economic, social, and cultural factors.

2.1.2.1 Climate factor

In Central Kalimantan Province, the climate factor during the dry season – low rainfall and high solar intensity – is one of the main drivers of forest and peatland fires. This condition usually occurs from June through November. The forest and peatland fire is likely to occur at an increased intensity and frequency when the El Niño is in effect. El Niño is a phenomenon where an increase in the sea surface temperature causes a change in climate patterns, which include a prolonged dry season, causing droughts and heat waves. In Indonesia, droughts often result in water scarcity in some regions, and eventually become one of the main factors for forest and peatland fires to happen.
2.1.2.2 Physical factor

The degraded forest and peatland's physical condition is one of the main factors contributing to forest and peatland fires. The degradation of forests and peatlands can be caused by logging activities or the conversion of forests and peatlands into settlements, farms, plantations, and mining operations. Moreover, the existence of ditches/canals made by local people to transport wood out of the forest also exacerbates the degradation of peatlands.

The development of canals and ditches in peatlands has caused excessive drought in dry seasons, threatening the integrity of peatland ecosystems. If a peatland experiences drought for a long time, the physical property and function of peat will change, and it can no longer retain nutrients and water. Therefore, degraded peat forests do not recover naturally, and are difficult to restore. Canals and ditches in peatlands are typically developed for logging, transportation and drainage for agricultural lands and plantations. Canals made without adequate control gates (sluice gates) can cause the drainage of water from the peat layers, which lowers the water level in the peatland, making it dry and flammable.

Degraded forest and peatlands with poor maintenance, which are overgrown with shrubs, abandoned and burnt, are more prone to fires because of the large amount of flammable materials left in the area. Sometimes, forest and peatland fires burn leaves and shrubs, instead of burning entire trees. These dead, partially burnt trees will become dry and very easily combustible for the next dry season.

2.1.2.3 Social, economic, and cultural factors

Social, economic, and cultural factors have also contributed to the destruction of forests and peatlands. Economic demands and the need for the development of the regions in Central Kalimantan Province are very high; logging, plantation development and farming are of highest priority for local communities. As a result, deforestation and the degradation of peatland due to the development of canals and ditches continue to threaten ecosystem integrity in the region, and dry the peatlands and increase the risk of fire in the dry season.

Human behavior is also one of the factors causing forest and peatland fires. Slash-and-burn is still a common method among local people because land preparation without the use of fire is viewed as being too expensive. The low income level of the people makes them choose the cheap, easy, and fast method to clear the land. Peat soil is also considered as being nutrient-poor and flooded with water all year – unfavorable conditions for farming. Therefore, at the time of land preparation, the water is drained from the peatland, and shrubs and understory vegetation are burnt, after which ashes from the burning will become a fertilizer and increase the soil's nutrient content. The desire to master the vast areas of land and abandoned them when no longer fertile, also becomes a main factor supporting the occurrence of disastrous forest and peatland fires.

2.2 Types of forest and peatland fires

Fires in forests and peatlands can occur above the ground (surface fire), which burns the biomass on the surface of a peatland. The fire spreads from tree to tree, and shrub to shrub, but does not burn the peatland belowground. Peatland fires can be categorized into two types: a surface peat fire and a deep peat fire (underground fire). A surface peat fire burns to a depth of 0-20 cm with its main fuel being grassroots, topsoil biomass and small twigs. On the other hand, an underground fire burns peat layers at a depth of 20-50 cm, where its main fuel is organic matters under the peat layers, roots and wood stems.
A high intensity surface fire that burns for a long duration will penetrate the surface peat layer, and can keep spreading downwards toward the deep peat layers. Figure 1, Figure 2, and Figure 3 show the development of a peat fire in a tropical peatland.

a. Land clearing conducted through clear cutting and burning is the main reason for surface fires. Such fires happen on the peatland's surface, on cleared land, and then it spreads out uncontrollably towards shrubs or other vegetation or into secondary peatland forest located between villages and forested areas. Although forest and peatland fires in cleared regions are high in intensity, underground fires rarely occur because the fire spreads too quickly across the cleared areas, making the fire duration much less and unable to burn into the deeper peat layers. For an underground fire to start, a high-intensity surface fire of long duration is needed for the peat layers to catch fire.

![Figure 1. The mechanism of forest and peatland fire on stage I](image1.png)

b. A prolonged surface fire will eventually burn surface peat via cracks in the peat soil, wood or waste materials, igniting in small cavities which extend into the peat soil. A fire will occur in the peat layers if there is a sufficient amount of fuel to maintain the fire's high temperature. After the surface peat has been burnt, the fire will eventually spread underground.

![Figure 2. The mechanism of forest and peatland fire on stage II](image2.png)

c. The fire then continues toward deeper layers of peat. An underground fire is the last stage of the peatland fire progression. The fire will spread underground slowly to various directions where there are dry flammable materials, without being affected by the wind. Pieces of wood buried under peat layers will also burn. Roots of standing trees can also burn; when the roots are destroyed, the trees will become unstable and collapse. Given the nature of an underground fire and the fact that only its smoke is visible on the surface, efforts to extinguish it will be extremely
difficult. Complete suppression of such a fire inside peatland can, and will, only be successful if the burnt peat layers are inundated by water.

Figure 3. The mechanism of forest and peatland fire on stage III

2.3 Impact of forest and peatland fires

2.3.1 Ecological impacts

The impact of forest and peatland fires on their environment is very broad, causing ecological damage through the decrease in biodiversity and its ecosystem functions, and also the decrease in air quality. In detail, the impacts of forest and peatland fires are as follows:

a. Carbon emissions
Peatlands store a large quantity of carbon in plant biomass, in litter under the forest soil, in peat layers and in mineral soil layers under the peat (substratum). Stored carbon will be released into the atmosphere quickly if the forest is cut down and degraded. Logging activities that are followed by burning will accelerate the emission process from peatland forest's biomass\(^5\). The forest and peatland fire will cause large amounts of CO\(_2\) gas emissions, and impact on global climate patterns.

b. Changes in the peat's physical property
Peat's important physical quality is its high level of moisture content, but it also has an irreversible drying tendency. Drought-experienced peatlands, caused by drainage, will suffer a decrease in volume, therefore lowering the soil surface (subsidence). If a forest and peatland fire happens, the impact will be much worse, for it will not only burn the peat, but the high temperature will also dry the unburnt peat layers, making them harder to recover.

c. Changes in peat's chemical property
Peat soil generally has a relatively high acidity level, ranging from pH 3 toward 5. Burning will increase the peat's pH, but lower its organic carbon content. One of the main causes of the change in peat's chemical property after burning is the high amount of ash produced from the burning. This change will afterwards affect the vegetation growth above.

d. Disruption of the peat's decomposition process because microorganisms will die in the fire.

\(e.\) Seeds from the natural vegetation, which were previously buried under the peat layers, will also be burnt, therefore disrupting the development and re-growth of plant species and the composition of the forest’s vegetation, changing it and lowering biodiversity.
f. Damage in hydrological cycle
Forest and peatland fires will decrease the absorption of rainwater into the soil, lowering its moisture level and increasing the amount of water running off the surface, affecting sedimentation and changing water quality. These conditions will cause the peatland to become dry and more vulnerable to forest and peatland fires. On peatlands close to the sea, damaged peatland hydrology will also cause sea water intrusion to reach further inland.

2.3.2 Human health impacts
Haze produced by forest and peatland fires contains several components detrimental to health in the form of gasses and small particles. Gas components which will affect peoples’ health include carbon monoxide (CO), sulphur dioxide (SO₂), nitrogen dioxide (NO₂), and aldehydes. Several other compounds, such as ozone (O₃), carbon dioxide (CO₂), and hydrocarbons also have devastating effects on the lungs. These various types of nitrite and organic nitrogen compound groups can travel far and be converted by other gases, such as ozone, or into very small particles and organic nitrites. Smoke particles from burnt wood are almost entirely < 1 μm in size, and mostly ranged from 0.15 to 0.4 μm⁶.

Haze polluted air entering the human body will affect the lungs and airways. It could damage everyone's health, whether they are healthy or sick originally, and especially those with in a weak condition. The elderly and children (also especially those who have a chronic disease) with the lower immune system are going to be more prone to health problems. As a result of haze inhalation, the lungs and respiratory system’s ability to handle any infection will decrease, causing people to become ill more easily. Respiratory diseases will develop much more quickly, mainly due to an imbalance in the immune system, the pattern of any bacteria or viruses, and poor environmental factors. In addition to respiratory infections, diseases associated with forest and peatland fires include pneumonia, asthma, eye irritations, and skin irritations.

Indonesia uses the term Pollutant Standard Index (PSI) to report the daily concentration of pollutants in the air. Air quality data for the PSI are obtained from the Department of Health or Regional Environmental Controlling Agencies or Regional Health Laboratories and other monitoring stations, owned by private companies. The government has already categorized the level of forest and peatland fire hazards based on the PSI and determined the necessary precautions for each category as shown in Table 1.

Table 1. Forest fire hazard categories and their precautions based on the PSI.⁷

<table>
<thead>
<tr>
<th>ISPU</th>
<th>Category</th>
<th>Health impact</th>
<th>Safety precautions</th>
</tr>
</thead>
</table>
| > 400 | Very dangerous| • Dangerous for everyone, especially children, pregnant women, the elderly, and people with respiratory problems. | • All have to stay at home and close the doors and windows.  
• Immediately evacuate selective people at risk such as: children, pregnant women, the elderly, and people with respiratory problems to a place/space free of air pollution |
| 300 - 399 | Dangerous | • For people with a disease, symptoms will be more serious.  
• Healthy people will feel easily tired. | • Patients with diseases are moved to an area free from air pollution.  
• Offices and schools must use an air conditioner or air purifier. |
| 200-299 | Very unhealthy| • In patients with respiratory infections, pneumonia, and heart disease, their symptoms will increase. | • Activities outside the home should be limited.  
• Need to have a special room prepared for the care of people with ARI / severe pneumonia in hospitals, health centers and others. |
2.3.3 Social and economic impacts

Forest fires also impact on the social and economic aspects of society. Several identified examples are as follow:

a. Loss of livelihood, especially for those who are dependent on forest resources, farming, livestock, hunting and fishing.

b. Disruption of transportation activities because of the poor visibility caused by haze. This will then lead to the disruption of economic activities.

c. Burning fields and other agricultural lands destroys crops, causing crop failure and bringing severe economic pressure onto the community.

d. Increasing local government or other agencies spending, and also losses to businesses and communities for the cost of extinguishing the fire, which can be very high if using advanced technology.

e. Misunderstandings between neighboring villages, which in turn could trigger horizontal conflicts between them.

f. Diplomatic problems with neighboring countries. Protests and demands from other nations may arise due to the impact from haze on them.

2.4 Efforts to minimize forest and peatland fires

To minimize the causes of fire, awareness by all stakeholders needs to be raised, especially by those who utilize fire to clear land. Using fire wisely and responsibly is crucial, and must be understood. For example, if one makes a fire inside the forest, the person must ensure that it is completely extinguished before leaving the site. While burning as a land clearing method should be avoided, if it has to be done, the fire must be controlled so it will not spread and become out of control. Tillage without a use of fire (zero burning) is the best method for peatland farming (see Section 2.4.2).

2.4.1 Controlled burning (on mineral soils)

Fires often spread out of the land which was initially intended to be burnt, because they are not controlled effectively. Ideally, land clearing through burning is not recommended, especially on peatland. In several regions in Indonesia, this method is still common among local farmers due to financial contrains and lack of proper tools and equipment in managing their lands. If this method has to be used and is permitted by the government, the activity needs to be limited on mineral soils and managed thoroughly and carefully as follows:

<table>
<thead>
<tr>
<th>AQI</th>
<th>Level</th>
<th>Health Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>Fine</td>
<td>No health effects</td>
</tr>
<tr>
<td>51-100</td>
<td>Medium</td>
<td>No health effects</td>
</tr>
<tr>
<td>101-199</td>
<td>Unhealthy</td>
<td>Can cause symptoms of irritation in the respiratory tract. For patients with heart disease, symptoms will be more severe. Use a mask or some cover for your nose and mouth when doing activities outside the home. Reduce activities for people with heart disease.</td>
</tr>
<tr>
<td>Controlled burning (on mineral soils)</td>
<td>✓ Burn only up to a maximum area of 2 ha / season / year for agriculture or plantation use.</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Before burning, the land owners must make firebreaks with a minimum width of 3 meters along the left and right sides of the land to be burnt.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ The village head and/or village staff must create a land-use map of the village land, and periodic reports of land clearing using the controlled burning method for the period from January to May and June to December, to be sent to the head of the subdistrict and forwarded to the head of the regency/Mayor.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Burn only up to a maximum of 0.5-1.0 ha / day / household and obtain permission from the village head first.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Village head permits the controlled burning on the aforementioned land, if the owner has:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- built firebreaks,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- cleared the ditches and water channels on the land,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- prepared fire extinguishing tools and equipment such as water pumps in anticipation of fires, and coordinated with neighboring landowners,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- signed a letter of responsibility verified by the village head.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Village chief permits controlled burning only in the morning (08.00 to 11.00) and afternoon (15.00 to 17.00) local time.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ At least five people appointed by the landowner, who are to be assisted by a member of RSA, must oversee the controlled burning process from start to finish.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Village head appoints one of the village staff (through a letter of assignment from the village head) to monitor the process and location for controlled burning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Village head divides the village into two zones (Zone 1 and 2 – for example, Zone 1 for areas north of a river/canal, and Zone 2 for areas south of a river/canal) and schedules the rotation of controlled burning, so that no simultaneous land burning is performed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ The applicant reports the entire process of the controlled burning to the village head by providing documentation of the burning, with date and time attached to the photographs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ The community finances controlled burning operations (the budget may come from the village funds, small businesses, or other parties) per fire post in each zone.</td>
<td></td>
</tr>
</tbody>
</table>

### 2.4.2 Zero burning land management on peatland

The tillage zero burning method involves some logging/felling activities and the removal of logs and waste materials as a result of land clearance. This method can be done mechanically or by a combination of manual and mechanical means. Mechanically, it can be performed by using heavy equipment such as tractors or bulldozers. The manual method employs tools such as axes, machetes and chainsaws. Mentioned below are the procedures for zero burning land management:
| Land clearing without burning | ✓ For a large land area, land clearing can be performed using tractors. Waste materials such as small twigs from trees and shrubs can be pushed away in the process.  
✓ Using tools pulled by a tractor to further cut up waste materials and convert it into mulch using a roller chopper. |
| Ploughing | ✓ Plough using tools such as a plow or tractor engine.  
✓ Plough only when plants need loose soil conditions.  
✓ Loosen the soil and flip it to a depth of 30 cm while burying the remains of plants that have become mulch. |
| Developing drainage trenches | ✓ Make trenches with sufficient depth and breadth between the plots by using a tool called an excavator. |
| Developing soil conservation infrastructures | ✓ Make ridges/beds to prevent erosion – do this on sloping lands. |

2.4.3 Protection and maintenance of community farms and plantations

To minimize the risk of forest and peatland fires, especially on communities' farms and plantations, regular maintenance must be carried out:

| Protection and maintenance of community farms and plantations | ✓ Remove grass/shrubs between the plants.  
✓ Plant legumes to cover top soils.  
✓ Leave waste materials (leaves, etc) around plants and trees to compost and enter the soil.  
✓ Make a shift to monitor the area when the fire hazard is high or during a long dry season.  
✓ Farmers should bring a broom for smothering flames and a water sprayer, which are easy to carry with them around the farm.  
✓ If possible, always keep on hand water-filled drums around the farm. |
3. Community-based fire prevention and control systems for tropical forests and peatland

A community-based fire prevention and control system for tropical forests and peatland consists of groups of activities, such as: preparation, information dissemination to local communities, fire prevention, fire suppression, and post-fire activities. This system is intended for community firefighting teams, also known as Regu Siaga Api (RSA) in Central Kalimantan. Its framework is illustrated in Figure 4 below.

![Diagram of Community-based fire prevention and control system framework](chart.png)

Figure 4. Community-based fire prevention and control system framework
3.1 Preparation and information dissemination (socialization)

3.1.1 Preparation and information dissemination procedure

The risk of fires is considered low during the wet season. In Central Kalimantan Province, the wet season generally occurs from December to May. Thus, most of the preparation, information dissemination, socialization and capacity building activities must be conducted during this time before the arrival of the dry season.

<table>
<thead>
<tr>
<th>Preparation and socialization on forest and peatland fire</th>
<th>✓ Establish firefighting teams (RSA) at village the level.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ Develop fire management strategies for each RSA, a work plan and monitoring plan.</td>
</tr>
<tr>
<td></td>
<td>✓ Build a village fire post.</td>
</tr>
<tr>
<td></td>
<td>✓ Make firebreaks in fire prone areas.</td>
</tr>
<tr>
<td></td>
<td>✓ Make access roads for patrols.</td>
</tr>
<tr>
<td></td>
<td>✓ Make dams to increase the water level for areas which tend to become dry and are prone to peat fires.</td>
</tr>
<tr>
<td></td>
<td>✓ Make an agreement between communities (with village regulations) concerning forest and peatland fire management, if it hasn't existed already. If it exists, socialize the regulations annually or before the dry season arrives each year.</td>
</tr>
<tr>
<td></td>
<td>✓ Socialize the fire hazards and provide trainings for villagers on how to open and manage their lands without burning them.</td>
</tr>
<tr>
<td></td>
<td>✓ Map fire-prone areas and peatlands in villages, and record landowners' names in those areas.</td>
</tr>
<tr>
<td></td>
<td>✓ Inventory both human and financial resources for prevention and controlling of fires every year, whether from the villagers, the private sector, or the regency government through the village head.</td>
</tr>
<tr>
<td></td>
<td>✓ Prepare fire extinguishing tools, transportation, water sources (wells, drills, etc.), and their distribution networks.</td>
</tr>
<tr>
<td></td>
<td>✓ Create and install warning signs in villages and fire prone areas, and broadcast announcements from the village head concerning the fire prevention activities.</td>
</tr>
<tr>
<td></td>
<td>✓ Conduct trainings and refresher activities for RSA members.</td>
</tr>
</tbody>
</table>

3.1.2 Establishment of firefighting teams (RSA)

3.1.2.1 Organizational structure

An organization which handles forest and peatland fire prevention and control must exist in every village. This organization needs to have its standard fire prevention and early detection activities organized at the village level in the form of a firefighting team (i.e., Regu Siaga Api or RSA). The organization must have management team members headed by a RSA leader. The RSA leader needs to be positioned directly under the village head, and responsible for managing the organization of the RSA and its fire management activities. If community lands are close to any concession lands, the concession owners should coordinate their forest and peatland fire prevention and control activities with the village head and RSA leader.
The RSA leader, secretary, treasurer and members may be selected by consensus through a village forum. Each RSA organization should be comprised of at least 10-15 people. Basic requirements for RSA members include:

- Villagers who are directly affected by forest and peatland fires;
- Adults aged 17-50 years old and can adapt to different conditions;
- People who are physically and mentally fit;
- People who are capable of working together in team;
- People who have experiences in fire management activities are preferred.

Figure 5 illustrates the organizational structure:

![Organizational structure of RSA](image)

3.1.2.2 Recommended functions and tasks of the RSA

a. RSA organizational functions and tasks
   1) Carry out fire prevention and early suppression activities;
   2) Undertake efforts to address the impact of forest and peatland fires in each village;
   3) Carry out RSA’s duties and rescue efforts in the event of a fire emergency in its village, and if needed, assist other RSA organizations in neighboring villages in fire fighting;
   4) Work with and assist research institutions to:
      - Conduct research activities and science and technology development in the field of forest and peatland fire
      - Develop technology and information systems (e.g., internet, GPS and mapping)
      - Conduct educational and training programs for communities
   5) Develop partnerships and network building with stakeholders;
   6) Facilitate village regulations and socialize them to communities;
   7) Seek funding for RSA’s operational costs.

b. Functions and tasks of each RSA position
   1) Village head
      a) As the dry season approaches, the village head gathers the RSA and other community leaders to have a village forum to devise a fire management action plan for their areas.
      b) Implement the action plan which includes monitoring, early suppression of fires, reporting to the neighboring villages, as well as reporting to the concession owners around the village area if the forest and peatland fire happens outside the village boundaries.
      c) Draft and issue village regulations (if they have not existed yet) to prevent forest and peatland fires.
      d) In performing his/her duties, the village head collaborates with local teachers, religious figures, community leaders, indigenous figures, and village officials.
e) Periodically report the action plans and the status of prevention and control efforts to the subdistrict head.
f) Gather villagers to raise awareness of the forest and peatland fire prevention and control efforts by encouraging them to make voluntary contributions in the form of money, rice, or anything else that will help support the actions of the RSA.

2) RSA leader
   a) Make decisions on behalf of his/her RSA organization.
   b) Distribute tasks within the members.
   c) Develop and distribute meeting materials.
   d) Together with the village head, map and update fire prone areas annually by observing the fire damaged areas in the current year.
   e) Report on the preparation of RSA, including the readiness of its members, tools and posts to the village chief and concession owners around the villages (if there's a collaboration pact) through the village head.
   f) Coordinate the RSA members to conduct routine monitoring on their respective areas in the dry season.
   g) Provide early warnings toward the whole community by informing the climate condition in the dry season.

3) Secretary
   a) List the members of the organization
   b) Deal with necessary correspondences
   c) Take meeting minutes and record any decisions reached
   d) Make a shift schedule for patrolling and manning at the fire post
   e) Make monitoring reports

4) Treasurer
   a) Report the RSA’s financial records
   b) Develop the RSA’s financial plans
   c) Conduct the RSA’s monetary and accounting activities

5) RSA members
   a) Assist RSA leaders to create a forest and peatland fire prevention and early suppression plan in the respective villages.
   b) Help map the fire-prone areas in respective villages based on the previous year's fires, the origin and source of fires, and the condition of the community's farming areas.
   c) Take responsibility for becoming agents of change on fire prevention and control for their community.
   d) Raise awareness on the importance of fire prevention by reminding their entire community to extinguish undesired small fires if they find them, wherever they are, either in village areas or other places.
   e) Man the fire post on a daily basis according to rotation shifts when the dry season is approaching.

3.1.2.3 Recommended functions and tasks of concession owners around villages
If there is a concession land area adjacent to villages, its owner should actively participate in the following activities:

a. Socialize the boundary of the concession area to each village, including the project objectives and plans.

b. Develop annual and long-term work plans for concession holder’s forest and peatland fire prevention and early suppression strategies, including initiating the establishment of an RSA in all the surrounding villages together with the village head.
c. Encourage the making of village regulations for the forest and peatland fire prevention and control in the respective regions.

d. Foster the sustainability of the RSA organizations, in coordination with the local government.

3.1.2.4 Communication, coordination and reporting flow
It is very important that information concerning forest and peatland fires is delivered to the stakeholders in villages and surrounding concession regions at the right time. Fire predictions, preparations, daily patrols, and early suppression have to be done by following the approved communication, coordination, and reporting flow as illustrated in Figure 6.

![Communication, coordination and reporting flow](image)

Figure 6. Communication, coordination and reporting flow

a. The RSA leader receives information from communities, patrols, satellite observations and other various sources, and coordinates with his members to determine the next appropriate level of preparation.

b. The RSA leader must report the results of ground check to the village head, the village secretary or other officials, and further coordinate with other villages' RSA leaders and concession owners around the area.

c. The RSA leader coordinates with the village head to be able to give orders to the RSA members and take appropriate prevention/extinguishment actions.

d. If the fire cannot be handled with by the RSA members, the village head has to immediately report this to other authorities and agencies, or report to the subdistrict head.

e. The subdistrict head coordinates with the sectoral police department's chief and local military.

f. In the event where the fire becomes out of control, the subdistrict head must report to the regency head.

3.1.2.5 Capacity building
In order to implement a reasonable and integrated system at the village level, the capability of the people needs to be developed to reach the required standards for field operations. There is no universal approach to capacity building for all villages, and it is important to prepare the RSA
members for the necessary steps to prevent and control forest and peatland fires in their respective villages by providing them with appropriate basic knowledge and skills.

These capacity requirements must be assessed before determining the type of information and support needed. Once the capacity building needs have been identified, the necessary training can be given to the RSA members and other village stakeholders (see “Capacity Building Training Module on Community-Based Tropical Forest and Peatland Fire Prevention and Control System” for complete training modules in the addendum of this document). A checklist for the assessment can be seen in Table 2.

Tabel 2. Capacity building needs assessment checklist

<table>
<thead>
<tr>
<th>Capacity needs</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>An RSA organization has been established and ready to take roles and responsibilities?</td>
<td>Training Module 3</td>
</tr>
<tr>
<td>Basic knowledge of forest and peatland fires has already been understood by the RSA members?</td>
<td>Training Module 1</td>
</tr>
<tr>
<td>Is the RSA able to create a fire-prone area map and action plans?</td>
<td>Training Module 1</td>
</tr>
<tr>
<td>Is there a network of communication and a reporting system?</td>
<td>Training Module 3</td>
</tr>
<tr>
<td>Are there complete sets of fire prevention and extinguishment tools, and communication and land transportation equipment organized?</td>
<td>Tool mobilization and training</td>
</tr>
<tr>
<td>Have peatland and forest fire extinguishment techniques been understood by the RSA members?</td>
<td>Training Module 2</td>
</tr>
<tr>
<td>Have water pipe drilling and installment techniques been understood by the RSA members?</td>
<td>Training Module 4</td>
</tr>
</tbody>
</table>

3.1.3 Firebreaks

A firebreak is a cleaned ditch free of grass or plants, which is meant to be used to prevent fire from spreading into areas where it is not desired. If flames burn the edge of the firebreak area, they will burn slower, giving the RSA team and the community nearby a chance to extinguish the fire before it spreads to other places.

Firebreaks with the width of only 3-5 meters would not be very effective, because flames can jump as far as 10-20 meters with a wind speed above 5 meters per second.

Establishing firebreaks has at least three objectives, namely:

a. Preventing the spread of fire out of the land being burned, meaning that firebreaks are established before the beginning of planting (or dry) season;

b. Preventing the spread of fire into areas that are not to be burned, or protected areas;

c. Fostering a sense of community in tackling fires, and establishing boundaries between parcels of land to prevent any tenural disputes.
### 3.1.3.1 The procedure for making firebreaks

#### Building firebreaks

| ✓ Choose areas to build firebreaks in protected areas, or in areas of high risk and frequent fires, such as:  
- Residential areas;  
- Land planted with trees (trees that are ready for production);  
- Land planted with crops; and  
- Grazing areas.  
| ✓ Prepare the equipment to use for building firebreaks, including machetes, hoes, harrows, chainsaws, hand saws, and other personal equipment.  
| ✓ Make firebreaks of 6 to 30 meters wide.  
| ✓ Maintain the firebreaks regularly by cleaning them every year to remove any existing fire hazards (e.g., leaves, twigs) in them.  
| ✓ Prepare firebreaks before the dry season arrives (around June).  
| ✓ To protect an area, to make it more secure, firebreaks should be made permanent by planting fire-resistant plants available or easily obtainable such as *Shorea Balangiran*, tumih (*Combretocarpus rotundatus* [Miq.] Danser), Galam or Cajeput Tree (*Melaleuca leucadendron*). Permanent firebreaks can also be created by planting liana vine which contains water.  
| ✓ Firebreaks will work well especially when flames are weak due to low wind speeds. In this case, planting trees such as hibiscus tree (*Hibiscus tilieaceus*) or the broad-leaved Ketapang or tropical almond (*Terminalia catappa*) in certain areas can serve as windbreaks that will reduce the spread of fire.  

#### Types of firebreaks

3.1.3.2 There are three types of firebreaks can be built on peatlands. RSA teams need to choose one or a combination of the types most appropriate for the location of the firebreaks.

a. Natural firebreaks:  
Existing naturally in nature, such as trenches, rivers, and cliffs.

b. Artificial firebreaks:  
Created by humans for a specific purpose including footpaths, highways, walkways, canals and wet rice fields.

c. Green firebreaks:  
Green firebreaks consist of live vegetation, including agricultural lands and especially natural forests parts of which always remain damp.

![Figure 7. Some types of firebreak](image-url)
3.1.3.3 *Planting along a firebreak*

Green firebreaks are paths of non-flammable vegetation with adequate width whose vegetation is deliberately planted to replace reeds or bushes. Plants for green firebreak lines must be of the types that are suitable for this purpose:

- Easy to grow and do not require intensive care
- Quick growing to provide shade to suppress populations of reeds
- Resistant to fire and easy to grow back after a fire
- Do not shed too many flammable dry leaves
- Succulent plants with thick leaves that stay green throughout the year

Trees should be planted very close to each other (for example, 1 x 1 m) in order to quickly form a dense canopy which will immediately suppress the growth of reeds or shrubs. The types of trees commonly used for green firebreaks especially around timber plantations include: Acacia (*Acacia auriculiformis*), A. mangium, kaliandra (*Calliandra calothyrsus*), and the easiest to grow is Ketapang or tropical almond (*Terminalia catappa*), Balangiran or Jabon (*Anthocephaalus cadamba*). We can also use banana plants as green firebreaks.

![Figure 8. Example of a firebreak being built](image)

3.2 *Fire prevention strategy*

3.2.1 *Early detection of fires*

Early detection and fast response to forest and peatland fires are very important in minimizing the damage caused by them and preventing further disaster. Catastrophic fires can be prevented early on by the RSA, if it is able to predict the level of fire risks, fire behavior, and prone areas. To predict them, RSA members must have knowledge of:

- The source of the fire;
- How the fire occurred;
- Weather conditions;
- Topographic conditions;
- Types of fuel.
Basic early warning signs for a fire hazard are as follows:

<table>
<thead>
<tr>
<th>Signs for early warning</th>
<th>✓ Communities’ planned farming and plantation areas, or areas of new openings such as canal construction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ The lowering of ground water levels (which means drought is coming) in the peat layers. This information can be obtained from water table measuring points where measuring pipes are installed. They should be installed in forested areas which can represent the village territory and away from canals and rivers to avoid inaccuracy.</td>
<td></td>
</tr>
<tr>
<td>✓ Receding river/canal levels (which means drought is coming).</td>
<td></td>
</tr>
<tr>
<td>✓ Crescent moon in the sky (i.e.: a tilting moon toward the ocean means flood is coming, and vice-versa), wood dying, or the position of stars in the dry season. Other natural signs are 'biting cold in the morning' or hearing birds chirping as a sign of the beginning of the dry season.</td>
<td></td>
</tr>
</tbody>
</table>

To determine whether or not the ground water levels have reached a dangerous level of dryness, one can directly measure water depths of the river or canal, as well as ground water levels in peat soils, by using a ruler. This can be conducted by mounting the ruler permanently.

Installation of this ruler in a canal or river should be done at low tide, where the zero point should be placed at the lowest water level (LWL). Observations of the rise of water level can be made using the metric scale indicated on the ruler. The unit used to measure the rise of water level is a centimeter or a meter. Data should be presented in the form of a line graph so that fluctuations in water level are clearly visible. Preliminary data (baseline data) must be observed every month for at least one year. The LWL of the river or canal in any month is an early indication of a drought occurring in the month. The fluctuation of the water level of the river or canal water is only an indication of the beginning of the dry season.

Measurements of peat soil water level, or ground water level (GWL), are done differently. Permanent measurement equipment can be made of PVC pipe with a minimum diameter of 3-5 cm. The length of the pipe should be at least 2.5 m, of which 2 m must be inserted into the soil and its bottom marked with a saw (at least 30 cm). The pipe is then inserted into the ground to a depth of 2 to 2.3 m and at least 50 cm should be above ground, as shown in Figure 9 below.

Ground water level measurements can be carried out manually using a ruler or stick with a metric scale marked on it. Ground water surface equals to the height of ground water according to the ruler or stick minus the height of the pipe (measured from the soil surface). The height of ground water can be used as a sign of vulnerability of an area to fire. For example:

- 0-20 cm: Normal
- 20-40 cm: Vulnerable
- 40-60 cm: Very vulnerable
- Over 60 cm: Extremely vulnerable

However the surface of peat ground water is still not enough to give a perfect picture; we should also measure soil moisture in each layer, using the same measurement.
For example:
0-20% (db, dry based): Extremely vulnerable
20-40% (db): Very vulnerable
40-60% (db): Vulnerable
Over 60% (db): Normal

Measurement of ground water can also be done in a simple way by using a hoe to dig into the
surface of the peat soil, for example, dig down to a depth of 40-60 cm and then wait for 5-10
minutes, until the ground water comes out, then measure the ground water level. Such a
measurement can be conducted easily at any place in areas that are considered prone to peat fires.

3.2.2 Fire prevention procedures

Fire prevention activities must be performed in areas prone to forest and peatland fires in the dry
season which typically occurs from June until November in Central Kalimantan. Regular monitoring,
routine patrols, and regular reporting are the main activities in this season, and every effort should
be made to prevent the occurrence and spread of forest and peatland fires.

<table>
<thead>
<tr>
<th>Fire prevention activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ RSA members perform patrols in the dry season, with a minimum of 2 (two) persons per shift to look for sources of fires in hotspots and/or other areas mapped as being prone to fires. Patrol frequency depends on local conditions, but it is suggested to be performed every day if the fire risk level is high, and every 2 (two) days if it is medium.</td>
</tr>
<tr>
<td>✓ Strengthen the participation of community members other than RSA members (e.g., taxi drivers) in patrols indirectly.</td>
</tr>
<tr>
<td>✓ Clean water drains and ditches.</td>
</tr>
<tr>
<td>✓ The fire posts should be manned 24 hours a day, with a 12-hour rotation shift by minimum two RSA members during the day and another two during the night.</td>
</tr>
<tr>
<td>✓ Varify any reports on fire events received from the community, and follow them up by conducting patrols and extinguishment activities.</td>
</tr>
<tr>
<td>✓ Each patrol member who discovers a fire of a small size in or outside the patrol areas, or anywhere else, must attempt to extinguish it using simple tools such as twigs or other materials available at hand.</td>
</tr>
<tr>
<td>✓ Monitor water level measuring tools.</td>
</tr>
<tr>
<td>✓ Monitor the rainfall.</td>
</tr>
<tr>
<td>✓ Perform fire patrol activities in accordance with the village decrees, and submit a formal report to the regency head.</td>
</tr>
<tr>
<td>✓ Strengthen the awareness campaign about the dangers of forest and peatland fire, and socialize zero-burning land management methods.</td>
</tr>
<tr>
<td>✓ Improve coordination and mobilization of all available resources.</td>
</tr>
<tr>
<td>✓ Use GPS (Global Positioning System) to create patrol tracks and report to the RSA leader.</td>
</tr>
<tr>
<td>✓ Report to the RSA leader on patrol activities, events, and any information obtained during duty periods.</td>
</tr>
</tbody>
</table>
3.3 Fire suppression strategy

3.3.1 Early fire suppression procedures
In the event when peat and forest fires occur, RSA members must mobilize all available resources to keep the fires from spreading and suppress them when they are still small. This is very important as underground fires on peatland are extremely difficult to be extinguished once they spread out of control. Key procedures are as follows.

<table>
<thead>
<tr>
<th>Early fire suppression activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ If the fire post receives information from a patrol team or from the community, after field verification, and if the fire cannot be extinguished by regular patrol activities, the RSA members must report the event to the RSA leader by a walkie-talkie radio.</td>
</tr>
<tr>
<td>✓ After receiving the information from the patrol team or the community, the RSA leader must then order RSA members to prepare their tools and transportation.</td>
</tr>
<tr>
<td>✓ The RSA leader must identify the source of the fire, its direction, the wind direction, the extent of the fire, any dangerous areas, and the availability of water sources. Then he must determine the extinguishment strategy and order the team members to set up the equipment and fight the fire.</td>
</tr>
<tr>
<td>✓ Prepare adequate personnel and logistics tools.</td>
</tr>
<tr>
<td>✓ Locate and close off fire-prone areas.</td>
</tr>
<tr>
<td>✓ Each member is responsible for his roles as assigned by the RSA leader, and barred from leaving the fire site.</td>
</tr>
<tr>
<td>✓ Attempt to extinguish the fire by spraying the fire (direct method; see Section 3.3.2.1).</td>
</tr>
<tr>
<td>✓ If this direct method is not successful, attempt to extinguish the fire by using the indirect method (see Section 3.3.2.2).</td>
</tr>
<tr>
<td>✓ If there is no water source nearby, try to isolate the fire from farther less vegetated areas by creating firebreaks, and attempt to extinguish the fire using simple tools while it is still small and has few materials to burn.</td>
</tr>
<tr>
<td>✓ The RSA leader must organize and command to the team members to fight the fire in targeted areas until it is completely extinguished.</td>
</tr>
<tr>
<td>✓ If the fire cannot be extinguished by the RSA, and if it is viewed as hazardous, the RSA leader must ask for help from concession owners around the village area, and for aid/assistance from other RSA organizations.</td>
</tr>
</tbody>
</table>

3.3.2 Fire suppression techniques
Fire suppression methods to be adopted should be determined depending on types of the fire – surface or underground fire (see Section 2.2.). This is because patterns which surface fires and underground fires spread is different, and thus suppression techniques should be differentiated as well.

3.3.2.1 Suppression of surface fires
Technically, suppression of surface fires can be performed by using two methods: the direct and indirect methods.
a. Direct method
The direct method can be performed using several techniques as described in Figure 10 and 11, depending on the burning area’s conditions such as the topography.

Figure 10. In areas of reeds and shrubs, firebreaks can be created by knocking down the reeds or shrubs to stop the spread of the fire. The chance of fire spread will be reduced, giving an opportunity to extinguish it.

Figure 11. If the fire is rather big, it can be suppressed by blocking the left and right of the burning area.

Direct method variations that can be done are:
1) Smothering fires
   This method is performed by patting the fire down to remove its oxygen with live wood twigs or coconut palm leaves, when the fire is still being spread above ground by burning dry twigs, leaves and grasses until they are out. If this method is used, make sure not to let any fire sparks jump.
2) Using soil/sludge
   This method is performed by spreading earth, soil or mud directly upon the fire source, using hoes or shovels. However, this method is often only effective on relatively small sized fires above ground.
3) Spraying water with a machine or by hand
   This method can be performed by using diesel powered water pumps, buckets, water trucks or a hydroplane.

b. Indirect method
   The indirect method is employed if the direct method cannot extinguish the fire. This method uses a wet line, firebreak, and a back fire.

   The indirect fire suppression method aims to control the fire by making firebreaks at certain distances from the edge of the fire. The basic principle of a firebreak is to block the spread of the fire. Once the fire is blocked by a firebreak, it will become smaller and easier to be extinguished. Natural barriers include rivers and swamps, and man-made barriers are firebreaks with a shape of trenches or paths.

1) The making of firebreaks in fire fighting
   a) Preparation
      i. The planned path for the firebreak is marked using bright-colored tapes or other signs; the distance need to be evaluated based on the rate at which the fire is spreading.
      ii. Fire breaks must be completely clean to prevent the spread of the fire. Cut and dispose of any fuel sources on the surface until the mineral soil below can be seen.
   b) Considerations in making firebreaks in fire fighting
      i. The scale of fire will determine the length of the firebreak that needs to be made.
      ii. The rate of spread of the fire will determine the distance between the firebreak and the fire.
      iii. The width of a firebreak depends on plant species in the fire areas and the topography. The width could be between one and four meters. Fire breaks on slopes above the burning area can be made slightly larger than those on flat surfaces.
      iv. The fire line should start and end where a natural firebreak exists or at a part of the burnt area which is already extinguished.
      v. The firebreak is made perpendicular to the direction of the spreading fire.
      vi. The number of personnel required depends on their skills and the length of the firebreak to be made.
      vii. Natural firebreaks should be utilized whenever possible to make fire suppression activities more efficient. A natural firebreak can help slow down the spread of the fire.
      viii. Each unit must always think about the safety of its personnel.
      ix. If the fire has been spreading, and firebreaks are to be developed by different RSA groups, their activities need to be coordinated well to make them work efficiently.

2) Indirect method variations
   a) Two-line method
      Two lines of firebreaks are made at a distance of one meter from the edge of the primary fire. RSA team members burn the area between the firebreaks and the primary fire so that the small fires set by the team will burn off the fuel source (e.g., grass, shrubs) and consequently reduce the intensity of the primary fire.
b) Parallel method

The firebreak is made at a distance of 1 m to 15 m from the primary fire, depending on the type of fuel sources, the fire intensity, and the field condition. The firebreak is made facing directly toward the primary fire. This method usually utilizes any natural barriers that exist nearby, such as roads and rivers.

Figure 13. Making firebreaks at the head of the fire and to right and left of the fire. This confines the fire and stops it from spreading, and the fire will extinguish by itself. Fire is kept from crossing the firebreaks; if there are any sparks that jump across, they must be immediately put out.

Figure 14. Parallel extinguishment method is usually performed by making firebreaks near the edge of the fire. The firebreaks are then connected to natural fire-breakers such as rivers or roads, so the fire is surrounded. Afterwards, the fire is extinguished using the combined ‘back fire’ method.
Figure 15. If there are no natural firebreaks, make lines surrounding the fire. The confined fire source will burn itself out. However, while the fire is burning inside the breaks; if there are any sparks, they must be put out immediately.

3) Firebreaks on a hillside
   Firebreaks are made on the back of the hill, on the slope opposite the primary fire. The line should be made not too far from the top of the hill where the degree of the slope is less than 20%.

3.3.2.2 Suppression of underground fires
Underground fires can be identified if there are smoke coming out of peat soils, and/or if land surface temperature is extremely high. In order to suppress underground fires, the following methods can be adopted.

a. Tilling the soil
   This method is performed to extinguish fires that occur at the surface layer of peat soils by tilling them with shovels, hoes, bush axes, and other similar tools.

b. Injecting water pipes
   This method is performed to extinguish underground fires (>50 cm deep) through an injection system by inserting the head of an iron pipe directly into the burning ground and spraying water underground. These iron pipes are called “nozzle protection sleeves”.

3.4 Post fire strategy
Post-burnt areas are prone to recurring fires. Dried litters and dead wood can easily become fuel sources for the subsequent dry season. Preventing fires in these areas requires good land management and strategies which are based on fire scar maps, lessons learned, and various impacts of forest and peatland fires. Such strategies are critical in order to increase the capacity of RSA members and prepare work plans for the next dry season.

Trees and other types of vegetation native to peatland should be planted and maintained in order to help rehabilitate and restore post-burnt areas and keep soil moisture high during the dry season. Prior to carrying out rehabilitation and restoration activities, in order to ensure the optimal outcome of the rehabilitation and restoration efforts, field surveys must be conducted to determine the appropriate silvicultural measures based on key factors including topography, vegetation cover, ground water level conditions, peat soil conditions, regeneration potentials, appropriate native plant species, and availability of human resources, as well as potential obstacles. In addition to the
rehabilitation of post-fire areas, degraded forest and peatland and abandoned shrub areas should be closely monitored and restored where possible, as such areas are also prone to fires in the future.

<table>
<thead>
<tr>
<th><strong>Post-fire activities</strong></th>
<th>✓ Analyze the cause of fire and its sources, burnt (fire scar) areas, and losses due to the fire.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓ Sketch a map of the fire scar and fire prone areas.</td>
</tr>
<tr>
<td></td>
<td>✓ Make fire prevention and control strategies for the fire-prone areas for the next dry season.</td>
</tr>
<tr>
<td></td>
<td>✓ Patrol the burnt areas – any remaining embers should be put out to prevent any new fires starting in the same area.</td>
</tr>
<tr>
<td></td>
<td>✓ Identify native tree species and their economic values to determine which trees are appropriate for planting on the burnt areas and around the firebreaks. Plant species that can be used for peatland rehabilitations are: Jelutong (<em>Dyera lowii</em>), Pulai (<em>Alstonia macrophylla</em>), Meranti (<em>Shorea sp.</em>), Terentang (<em>Camposperma macrophyllum</em>), Tumih (<em>Combretodatus rotundatus</em>), Keranji (<em>Dialium hydnocarpoidea</em>), Punak (<em>Tetramerista glabra</em>), Resak (<em>Vatica sp.</em>), Rengas (<em>Melanorrhoea wallichii</em>), Belangeran (<em>Shorea belangeran</em>), Ramin (<em>Gonystylus bancanus</em>), Forest Durian (<em>Durio carinatus</em>), and Kempas (<em>Koompassia malaccensis</em>).</td>
</tr>
<tr>
<td></td>
<td>✓ Prepare new plants, including seeds, seedlings, and a nursery.</td>
</tr>
<tr>
<td></td>
<td>✓ Rehabilitate the land by improving the water management system by managing the ground water level needed to stabilize the natural condition of peatland forest. Local communities can participate in this activity, together with any concessionaires around it.</td>
</tr>
<tr>
<td></td>
<td>✓ Rehabilitate the degraded forest and peatland areas, especially abandoned shrub land and along banks of canals/rivers 100-200 m from the edge. Shrub and bushes are extremely prone to fires during dry seasons. Replanting using economically and ecologically valuable plants – e.g., rubber tree, Jelutong, and other local fruit trees such as Nangka, Durian, and Cempedak. Local communities can participate in this activity, together with concessionaires around it.</td>
</tr>
<tr>
<td></td>
<td>✓ Close/dam trenches and canals on peatland to increase the ground water level, but this must be designed and developed in a way which local transport (e.g., speedboat and long boat) will not be disturbed and can continue to pass through.</td>
</tr>
<tr>
<td></td>
<td>✓ The RSA leader writes post-fire analysis reports and share lessons learned from the current year to the RSA member and the villagers.</td>
</tr>
</tbody>
</table>

### 3.5 Equipment and infrastructure

#### 3.5.1 Deep water well

Land management requires a large volume of water, which is not only used for firefighting activities but also for plant maintenance and other needs.

A wellbore in peatlands, commonly called a “deep well”, is one of the methods to obtain water during the dry season. This method is particularly useful in areas in which access to water sources is difficult (e.g., far from rivers) and fires tend to occur frequently.
a. Well drilling equipment

Deep well drilling requires the following equipment and materials (per set):

Tabel 3. List of tools and materials required to make a wellbore on peatland

<table>
<thead>
<tr>
<th>No</th>
<th>Nama alat dan bahan</th>
<th>Jumlah (unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PVC pipe 1.5 inch in diameter and 4 m in length</td>
<td>5 unit</td>
</tr>
<tr>
<td>2</td>
<td>Straight pipe connector</td>
<td>5 unit</td>
</tr>
<tr>
<td>3</td>
<td>Pipe glue and white duct-tape</td>
<td>1 unit</td>
</tr>
<tr>
<td>4</td>
<td>Portable diesel powered water pump (Kubota GS/KS 160)</td>
<td>1 unit</td>
</tr>
<tr>
<td>5</td>
<td>Drill bit</td>
<td>1 unit</td>
</tr>
<tr>
<td>6</td>
<td>Drill pipe and connector</td>
<td>20 m</td>
</tr>
<tr>
<td>7</td>
<td>'U'-shaped pipe connector</td>
<td>1 unit</td>
</tr>
<tr>
<td>8</td>
<td>Pipe wrench</td>
<td>2 unit</td>
</tr>
<tr>
<td>9</td>
<td>Pipe clamp lock / vise</td>
<td>1 unit</td>
</tr>
<tr>
<td>10</td>
<td>Hacksaw</td>
<td>1 unit</td>
</tr>
<tr>
<td>11</td>
<td>Plastic hose to connect the engine to the drilling pipe</td>
<td>1 unit</td>
</tr>
<tr>
<td>12</td>
<td>Other supporting tools such as machetes, hoes, shovels, axes, rubber tires, plastic sheeting, buckets, and plenty of water</td>
<td>1 unit</td>
</tr>
</tbody>
</table>

b. Making of a wellbore

1) Preparation
   a) Prepare the PVC pipe by slitting it, using a hacksaw to create water absorption lines on a pipe of 2-3 meters in length.

   ![Figure 16. Hacksawing the PVC pipe to be installed at the bottom of the wellbore](image)

   b) Determine where to drill the wellbore.
   c) Make a water reservoir pool with a depth of ± 50 cm and width 50 cm x 50 cm. The bottom is layered with a tarpauline sheet to prevent the water from seeping into the ground.
   d) Prepare a drilling pipe with an drill bit, and connect them to a hose to drain the water from the diesel powered water pump.

2) Machine installation
   a) Prepare the diesel powered water pump with enough fuel and oil for the machine.
   b) Connect the hose to the drill and suction engine pipe in the water reservoir pool.
   c) Turn on the diesel powered water pump until water comes out of the drill bit.
3) Drilling
   a) Place the drill bit into the designated spot slowly.
   b) By using the clamping key/vise, turn it halfway around while pushing the pipe until it penetrates the peat layers.

   ![Figure 17. Drilling on the designated spot](image)

   c) After the first pipe only protrudes 50 cm above the ground, reduce the diesel powered water pump’s speed and, using the pipe clamp, open the joint and connect another pipe to it.
   d) Once the pipe is connected, increase the diesel powered water pump’s speed.
   e) With the second pipe now entering the ground, the drill bit usually touches hard granite soil. Use the half-turn technique while pushing the drill hard and if there feels less movement, add a little bit of speed to be able to bring the drilled soil out of the hole.
   f) Insert a third pipe, which should reach fine sandy soil.
   g) Clean the drill of any fine sand particles by rinsing it in the water reservoir, so the sand will not enter the pump.
   h) The fourth pipe should reach coarse sand and small pebbles – this is a sign that the drill has reached a water source, and if it hasn't, then insert a fifth pipe.
   i) After the drill bit reaches the water source, turn off the diesel powered water pump and remove the drilling pipes quickly to avoid them binding (sticking) in the sand below.
   j) Insert the PVC pipe with its base already slit and its end closed. Insert the pipe by pushing it into the ground. Do it until the pipe reach the water source.

   ![Figure 18. Inserting a pipe shortly immediately after the drilling pipe is removed](image)
k) Install/mount the diesel powered water pump and connect it to the PVC pipe. Turn on the pump until water flows out of the wellbore.

Figure 19. Pemompaan air dari sumur bor untuk pertama kalinya

c. Considerations in making deep water well
   1) The water depth in a wellbore on peatland usually varies.
   2) If only a small amount of water is coming out of the pump, check the PVC pipe’s joint with the pump. If it is leaking, seal it using rubber bands.
   3) It is advised to identify and map available water sources in the forest and peatland areas which are prone to fires. This should be performed during the dry season so that there is a great chance that these identified water sources are still filled with water in the event when a forest and peatland fire occurs. Furthermore, coordinates of the water sources should be mapped to make it easy to find them if there is a fire.
Figure 20. The layout of tools and the water pumping machine in the making of a deep well. Figure 20 below shows the process of wellbore making and the layout of drilling tools and the diesel powered water pump. Water from the reservoir is sucked by the pump, which is then channeled into the hose and into the drilling pipe. The pressure of this water spray loosens the soil whilst drilling is in progress. Water coming out of the wellbore is then channeled back into the reservoir. This process continues until the water source is reached.

Figure 20. The layout of tools and the water pumping machine in the making of a deep well.
On peatland, the depth of the water source can vary. Thus, the depth of the wellbore will not be the same everywhere. However, generally speaking, the water source can be found at a depth of 12-20 meters. Figure 21 below shows the different layers of peat soil which will be penetrated by the drill before it reaches the water source.

3.5.2 Fire post

a. The fire post is a post for RSA’s monitoring and firefighting, and to support their technical activities in the field.

b. These posts should be approximately 12 meters in height above the peat’s surface, and can be constructed in many places for monitoring fire hotspot areas from various directions. Thus, it is expected that they can help with early warning of, and preparation for, handling fire events.
c. Fire posts are managed by each respective village, and could also be utilized as a community service area (e.g., motor repair shops, water refilling kiosk, or other productive activities) in the future.

3.5.3 Transportation
a. In order to effectively conduct patrolling and monitoring activities, the RSA teams need to be able to access simple means of transportation such as a long boat.
b. Boats or similar mode of transportation must be readily available in order for the RSA members to provide timely assistance in emergencies.
c. Long boats or speed boats may be rented from the local communities, companies or other organizations nearby.
d. In addition to preparing water transport, making access roads for patrolling is important before the arrival of the dry season, as the water levels of nearby river/canal may be quite low, allowing insufficient clearance for the passage of water transport (such as a long boat).

3.5.4 Fire suppression equipment
a. Minimum equipment for RSA
The equipment employed by an RSA organization in prevention and firefighting activities should consist of, at minimum, the followings:

Table 4. Types of equipment and the minimum amount required by the RSA

<table>
<thead>
<tr>
<th>No</th>
<th>Jenis Peralatan</th>
<th>Jumlah</th>
<th>Keterangan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robin diesel powered water pump and suction hose</td>
<td>2 units</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.5 inch water hose</td>
<td>10 roll</td>
<td>@ 50 m</td>
</tr>
<tr>
<td>3</td>
<td>Surface fire extinguisher</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Peat fire extinguisher</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Water pipe</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Deep wellbore auger</td>
<td>1 unit</td>
<td>Complete list of the wellbore-making equipment is listed in the previous chapter (Section 3.5.1).</td>
</tr>
<tr>
<td>7</td>
<td>1000 liter water container</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Harrow</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hoe</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Axe</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Scythe</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Handsaw</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Mobile pump Jufa, 15 liters</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Walkie-talkie</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Bucket</td>
<td>2 pcs</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Rubber boots</td>
<td>15 pcs</td>
<td>@ one pair for each team member</td>
</tr>
<tr>
<td>17</td>
<td>Haze resistant white glasses</td>
<td>15 pcs</td>
<td>@ one pair for each team member</td>
</tr>
<tr>
<td>18</td>
<td>Jumpsuits</td>
<td>15 pcs</td>
<td></td>
</tr>
</tbody>
</table>
In addition to the above equipment, supplementary equipment is also required to support the RSA teams’ efforts in fire prevention or extinguishing activities:

Table 5. List of supplementary equipment for RSA team

<table>
<thead>
<tr>
<th>No</th>
<th>Nama Alat Tambahan</th>
<th>Jumlah (unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GPS</td>
<td>1 unit per team</td>
</tr>
<tr>
<td>2</td>
<td>Village/fire-prone area map</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Tape measure or similar item capable of measuring a 50 m and 100 m distance</td>
<td>1 unit per team</td>
</tr>
<tr>
<td>4</td>
<td>Compass</td>
<td>1 unit</td>
</tr>
<tr>
<td>5</td>
<td>Digital camera</td>
<td>1 unit</td>
</tr>
<tr>
<td>6</td>
<td>Desktop computer (if internet is needed/available)</td>
<td>1 unit</td>
</tr>
<tr>
<td>7</td>
<td>Stationary for making the fire maps (large paper)</td>
<td>10 sheets</td>
</tr>
<tr>
<td>8</td>
<td>Gauge for measuring burnt peat depths</td>
<td>1 unit</td>
</tr>
<tr>
<td>9</td>
<td>Clipboard for writing on and pencils/pens and notebooks (per person)</td>
<td>1 unit</td>
</tr>
<tr>
<td>10</td>
<td>Anemometer (wind speed measuring device)</td>
<td>1 unit</td>
</tr>
<tr>
<td>11</td>
<td>Hygrometer (air humidity measuring device)</td>
<td>1 unit</td>
</tr>
<tr>
<td>12</td>
<td>SSB radio</td>
<td>1 unit</td>
</tr>
</tbody>
</table>
3.6 RSA monitoring plan

The recommended monitoring procedures for community-based forest and peatland fire prevention and control systems to be used by an RSA organization are as follows:

<table>
<thead>
<tr>
<th>Fire Control Monitoring Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community-Based Tropical Forest and Peatland Fire Prevention and Control Systems</td>
</tr>
</tbody>
</table>

### I. PREPARATION AND INFORMATION DISSEMINATION

1. Check and monitor the RSA’s work plan and strategy before the dry season (May-December):
   - a) Maps available/prepared of the peatland and fire-prone areas in the village territories
   - b) Names of the owners whose lands are located within fire-prone village areas recorded
   - c) Information dissemination, campaigns, and socialization activities about the dangers of forest and peatland fires and prevention approaches prepared.
     - Names of person in charge (RSA, staff from a government agency, NGOs, companies)
     - Names of invitees to the socialization events?
     - The form of the counseling/socialization/campaigns
     - Times of such events
     - Aids provided (if any)
   - d) Firebreak development plans prepared
     - Locations
     - Names of person in charge

2. Check and monitor RSA’s equipment and infrastructure before the dry season (May-December):
   - a) Fire post
   - b) First aid kit and medicines
   - c) Means of transportation
   - d) Access roads for patrolling
   - e) Equipment (see Section 3.5 for a list of equipment required for RSA)

3. Check and monitor the organizational effectiveness of the RSA:
   - a) RSA’s personnel list:
     - Member name and title
     - Member contact information
   - b) Health of RSA members
   - c) Basic knowledge and trainings provided to the RSA members (see Section 3.1.2.4 for capacity building):

<table>
<thead>
<tr>
<th>List of basic knowledge for RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Organizational management of RSA</td>
</tr>
<tr>
<td>2. Basic knowledge about forest and peatland fires</td>
</tr>
<tr>
<td>3. Basic knowledge about making fire-prone area and fire scar maps</td>
</tr>
<tr>
<td>4. Communication and coordination systems of RSA</td>
</tr>
<tr>
<td>5. Usage and function of tools and equipment</td>
</tr>
<tr>
<td>6. Techniques for the suppression of forest and peatland fires</td>
</tr>
<tr>
<td>7. Basic knowledge about making water sources (deep well bores and reservoirs)</td>
</tr>
</tbody>
</table>

   - d) Record RSA’s meeting minutes and coordination:
     - Time of the meeting
     - Invitees’ names
   - e) Amount of funding available for RSA’s activities

4. Check and record reports on preparation activities produced by the RSA:
   - a) Date of the report produced
### II. FIRE PREVENTION

1. Check and monitor fire-prone areas and hotspots identified from any early indication or residents’ reports (*ground check*):
   - a) Early fire warnings or residents’ reports
   - b) Location of fire-prone / hotspot areas:
     - Coordinates
     - Names of land owners / concessionaires, village, subdistrict, and regency
   - c) Times of patrolling
   - d) Names of patrollers
   - e) Equipment used
   - f) Environmental situation/condition around the fire-prone/patrolling areas
     - Types of primary vegetation
     - Types of soil: mineral or peat
     - Is there a forest nearby?
     - Are there plantations?
     - Are there farmlands?
     - Are there residential buildings nearby?
   - g) If available, measure and monitor by using installed equipment
     - Ground water levels
     - Rainfall
     - Wind speeds and direction

2. Record and monitor information dissemination/socialization/campaign activities about fires which were given to communities, either by the RSA or from a government agency, NGOs, companies, etc.
   - a) Names of presenters
   - b) Names of invitees
   - c) Location
   - d) Type of the event
   - e) Date of the event
   - f) Aid provided (if any)

3. Check and record reports on prevention activities produced by the RSA:
   - a) Date of the report produced
   - b) Name of the writer

### III. FIRE SUPPRESSION

1. Document and monitor fire suppression activities conducted by the RSA:
   - a) Time when the fire occurred
     - Hour/date/month/year
   - b) Time when the fire was extinguished
     - Hour/date/month/year
   - c) Location of the fire
     - Coordinates
     - Names of land owners / concessionaires, village, subdistrict, and regency
   - d) Environmental situation at the site of the fire
     - Types of primary vegetation at the location
     - Type of soil: mineral or peat
     - Is there a forest nearby? (distance____m)
     - Is there a concession nearby? (concession type____; distance____m)
     - Are there community plantations/farms? (distance____m)
     - Are there residential buildings nearby? (distance____m)
     - Are there access roads available? (distance____m)
<table>
<thead>
<tr>
<th></th>
<th>Water sources used</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Coordinates</td>
</tr>
<tr>
<td>b</td>
<td>River</td>
</tr>
<tr>
<td>c</td>
<td>Canal/trenches</td>
</tr>
<tr>
<td>d</td>
<td>Deep well</td>
</tr>
<tr>
<td>f</td>
<td>Names of the agencies/organizations/companies involved in extinguishing the fire</td>
</tr>
<tr>
<td>g</td>
<td>Equipment, means of transportation, and method used</td>
</tr>
<tr>
<td>h</td>
<td>Activities at the fire post</td>
</tr>
<tr>
<td>i</td>
<td>If available, measure and monitor by using installed equipment</td>
</tr>
<tr>
<td></td>
<td>▪ Ground water levels</td>
</tr>
<tr>
<td></td>
<td>▪ Rainfall</td>
</tr>
<tr>
<td></td>
<td>▪ Wind speeds and direction</td>
</tr>
</tbody>
</table>

2 Check and record reports on fire suppression activities produced by the RSA:  
   a) Date of the report produced  
   b) Name of the writer

### IV. POST-FIRE MANAGEMENT

1 Map and monitor the post-fire areas:  
   a) Time when the fire occurred:  
      ▪ Hour/date/month/year  
   b) Time when the fire was extinguished:  
      ▪ Hour/date/month/year  
   c) Cause or source of the fire  
   d) Burnt location  
      ▪ Coordinates  
      ▪ Names of land owners / concessionaires, village, subdistrict, and regency  
   e) Environmental condition around the burnt area  
      ▪ Types of primary vegetation at the location  
      ▪ Type of soil: mineral or peat  
      ▪ Is there a forest nearby? (distance____m)  
      ▪ Is there a concession nearby? (concession type____; distance____m)  
      ▪ Are there community plantations/farms? (distance____m)  
      ▪ Are there residential buildings nearby? (distance____m)  
      ▪ Are there access roads available? (distance____m)  
   f) Size of the burnt area (Ha)  
   g) Estimation of losses caused by the fire

2 Document restoration and rehabilitation activities performed:  
   a) Location  
      ▪ Coordinates  
      ▪ Names of land owners / concessionaires, village, subdistrict, and regency  
   b) Size of the area (Ha)  
   c) Names of people who are involved in the activities (communities, staff from a government agency, NGOs, companies)  
   d) Time of the restoration and rehabilitation activities  
   e) Environmental situation in the restoration and rehabilitation site  
      ▪ Types of primary vegetation at the location  
      ▪ Type of soil: mineral or peat  
      ▪ Access roads (distance____m)  
   f) Water sources (distance____m)

3 Check and record reports on post-fire management produced by the RSA:  
   a) Date of the report produced  
   b) Name of the writer
Endnotes

2 Badan Pusat Statistik data available at: http://www.bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=60&notab=4
3 The distribution of peatland varies from 13.5 million to 26.5 million ha (average 20 million ha), depending on research results. Details available at: http://www.menlh.go.id/koordinasi-kelembagaan-pengelolaan-lahan-gambut-di-indonesia.
Annex 1.

**Capacity Building Training Module for a Community-Based Fire Prevention and Control System for Tropical Forests and Peatlands**

This training module has been developed jointly by the Center for Forest Fire Control and Rehabilitation, Institute of Community Services (LPKM), University of Palangkaraya, Puter Indonesia Foundation and Starling Resources, for a REDD+ 2014 Feasibility Study commissioned by Marubeni Corporation and funded by the Japanese Ministry of Economy, Trade and Industry.

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Supported by

Marubeni Corporation
INTRODUCTION

Fires in tropical forests and peatlands have been occurring almost every year during the past two decades. Fire disasters have multiple negative impacts on wildlife, human health, and the economy. The frequency and extent of peat and forest fire events in Indonesia implies that effective fire-prevention measures and early-control systems are not yet in place. The awareness of business owners and the general public about the dangers of fires in tropical peat forests and peatlands is still inadequate.

A community-based fire prevention and control system should be geared toward early fire prevention measures in order to minimize the impact of fire before it spreads uncontrollably into a disaster. Training provided to communities should be tailored to their needs, and the main targets of such training are the members of firefighting teams, or locally known as RSA (Regu Siaga Api), which may already exist or is to be established. An assessment of RSA members’ capacity and needs should be conducted before determining what training is needed for them.

Basic Training in Fire Prevention and Control in Tropical Forests and Peatland is intended to prepare RSA teams to be able to effectively manage fires in forests and peatlands in or around their villages, and to avoid the danger of wild fires. Moreover, the objective of this training is to provide RSA members with basic knowledge and skills to be used for fire prevention measures in forest and peatland areas appropriately, and to ensure all efforts and activities can be carried out well in a coordinated and integrated way.

This document consists of four modules, namely:

1. Overview of peat forest and peatland fires
2. Techniques for prevention and control of peatland and peat forest fires
3. Management of firefighting teams for forest and peatland fires
4. Techniques for wellbore making on peatlands

These training modules were written to be used by trainers to provide RSA members or local communities with practical steps on forest and peatland fire management, and the learning process may be implemented in discussion forums, in classrooms, and in the field. The modules need to be modified as appropriate to tailor them to the needs and conditions at each site where they will be applied. The reading material for participants is provided in the “Guidebook for the Community-Based Fire Prevention and Control System for Tropical Forest and Peatland”.

These training modules were developed and tested in the field with significant contribution from RSA team members from the villages of Kampung Melayu, Tewang Kampung and Mendawai in Mendawai Sub-District, in the District of Katingan, Central Kalimantan Province, along with Gambut Lestari RSA, which all work together to secure their village areas and the concession site of PT Rimba Makmur Utama (RMU).
MODULE I: OVERVIEW OF FOREST AND PEATLAND FIRES

1. Objectives
In this module, participants will learn about the characteristics of forest and peat fires. The objective is that participants are able to understand peatland and are able to determine the characteristics and types of fires in peat forests and peatlands. The participants will be provided with the following basic knowledge:
- Knowledge and types of peat in Central Kalimantan
- Types of fires that occur on peatland
- The causes of forest and peatland fires
- The negative impacts of forest and peatland fires

The key question for directing the discussion is “What are the causes and impacts of fires?”

2. Target Participants
Module I is about the basic knowledge that should be understood by all parties who manage peatlands. The community and firefighting teams are the main participants targeted by Module I along with local government officials such as village heads, police and other security forces.

3. Methodology
The methods used for training Module I include:
- Active discussions in small groups
- Active discussions among all participants
- Lecture using a PowerPoint presentation

To support these methods, the following tools and materials need to be prepared:
- Large marker pens;
- Flipchart/plano paper;
- Masking tape;
- Computer and LCD Projector.

4. Process
Training Module I will run for 90 minutes using the following process:
1) The facilitator opens the Module I training session.
2) The facilitator starts by explaining the topics to be covered and key discussion points.
3) The facilitator divides the participants into small groups consisting of firefighters, the village head and other government officials. Each group should consist of 5 to 6 members.
4) The facilitator asks each group to identify and write down on a flipchart what factors lie behind fires. The notes on the flipchart can use the layout in the following table:
5) The facilitator helps to summarize all factors relating to the occurrence of fires, writes them on a flipchart, and asks participants to divide these factors into two categories. What are the natural processes and human activities which cause fires?

6) The facilitator asks each group to try to analyze the impact/risk of fire and write the results on their flipchart. The facilitator can help participants to write them by using the following example of a format:

<table>
<thead>
<tr>
<th>Environment</th>
<th>Health</th>
<th>Economic</th>
<th>Physical</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. ............</td>
<td>b. ............</td>
<td>b. ............</td>
<td>b. ............</td>
<td>b. ............</td>
</tr>
<tr>
<td>c. ............</td>
<td>c. ............</td>
<td>c. ............</td>
<td>c. ............</td>
<td>c. ............</td>
</tr>
<tr>
<td>d. ............</td>
<td>d. ............</td>
<td>d. ............</td>
<td>d. ............</td>
<td>d. ............</td>
</tr>
</tbody>
</table>

7) The facilitator then asks each group to create a fire hotspot map by sketching locations of fire sources and how fires spread around their respective villages. The facilitator can help participants to draw this map using the following example:

8) After the group discussion, each group presents the results of their discussion, and other groups can respond.

9) After the presentations by each group, the facilitator asks the participants to review how fires start and spread with additional explanation from a speaker/expert. Then the facilitator invites the speaker/expert to begin their lecture.

10) The facilitator closes the Module I training session after a question and answer session.
MODULE II: TECHNIQUES FOR PREVENTION AND CONTROL OF PEATLAND AND PEAT FOREST FIRES

1. Objectives
In Module II, participants will learn about prevention and control of forest and peatland fires. The objective is that participants know and understand the methods and techniques of prevention and control of fires. The participants will be introduced to:

- Methods of fire prevention and control on forest and peatland
- Manual firefighting equipment
- Techniques for extinguishing fires on forest and peatland

The key question for directing the discussion is “What efforts have already been made so far regarding fire prevention and control activities, and what can be improved?”

2. Target Participants
The community and firefighting teams are the main participants targeted by Module II although it can also be followed by others such as village heads, police and other security forces.

3. Methodology
The methods used for training Module II include:

- Active discussions in small groups
- Active discussions among all participants
- Lecture using a PowerPoint presentation

To support these methods, the following tools and materials need to be prepared:

- Large marker pens;
- Flipchart/plano paper;
- Masking tape;
- Computer and LCD Projector.

4. Process
Training Module II will run for 90 minutes using the following process:

1) The facilitator opens the Module II training session.
2) The facilitator starts by explaining the topics to be covered and invites a speaker to give a lecture on techniques for fire prevention and control in forest and peatlands. The facilitator will guide a question and answer session during or after the lecture.
3) The facilitator divides the participants into two groups consisting of firefighters, the village head and other government officials. Each group will discuss fire prevention and suppression efforts.
4) The facilitator asks each group to begin their discussions and write results on a flipchart. Each group writes ideas about efforts that can be made to prevent and control fires, what obstacles there may be and what the solutions are. The notes recorded on the flipchart can use the layout in the following table:
<table>
<thead>
<tr>
<th>Prevention Efforts</th>
<th>Obstacles</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Patrols</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ..................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ..................</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Efforts</th>
<th>Obstacles</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Making firebreaks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ..................</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ..................</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5) The facilitator asks the participants to gather together again, and then invites one person from each group to present their results followed by a question and answer session, where the rest of participants are invited to make comments and give input to the presenting group.

6) The facilitator provides an opportunity for other groups to present their results followed by a question and answer session, where the rest of participants are invited to make comments and give input to the presenting group.

7) The facilitator closes the Module II training session.
MODULE III: MANAGEMENT OF FIREFIGHTING TEAMS FOR FOREST AND PEATLAND FIRES

1. Objectives
In this third module, participants will learn about the management of an organization, specifically firefighters (RSA). The objective is for the participants to understand the importance of the organization and then be able to plan, organize, direct, coordinate and supervise the activities for the prevention and control for peatland and peat forest fires.

The key question for directing the discussion is “What are the plans which will be implemented first in the prevention and suppression of fire, and what are people’s respective roles?”

2. Target Participants
Members of RSA teams are the main participants targeted by this module.

3. Methodology
The methods used for training Module III include:
- Active discussions in small groups
- Active discussions among all participants
- Lecture using a PowerPoint presentation

To support these methods, the following tools and materials need to be prepared:
- Large marker pens;
- Flipchart/plano paper;
- Masking tape;
- Computer and LCD Projector.

4. Process
Training Module III will run for **120 minutes** using the following process:
1) The facilitator opens the Module III training session.
2) The facilitator starts by explaining the topics to be covered and invites a speaker to give a lecture on organizational management of RSA for forest and peatland forest fire prevention and control. The facilitator will guide a question and answer session during or after the lecture.
3) The facilitator divides the participants into four groups composed of RSA teams, and explains the purpose of the group discussion which will be drawing up an RSA work plan.
4) The facilitator asks each RSA to begin discussion and draw up the work plan. This plan should be recorded on the flipchart, using the layout in the following table:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Person in charge</th>
<th>Partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation period – during the rainy season (no fire sources): from month… to month…</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Make a firefighting strategy</td>
<td>a. Head of RSA team</td>
<td>a. Village Head</td>
</tr>
<tr>
<td>b. ………………</td>
<td>b. ………………</td>
<td>b. ………………</td>
</tr>
<tr>
<td>c. ………………</td>
<td>c. ………………</td>
<td>c. ………………</td>
</tr>
<tr>
<td>Fire-prone period – during the dry season: from month… to month…</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Carry out village patrol</td>
<td>a. Head of RSA team</td>
<td>a. Village Head</td>
</tr>
</tbody>
</table>


5) The facilitator asks the participants to gather together again and then invites the first group to present their results followed by a question and answer session, where the other groups is invited to make comments or give input to the first group.

6) The facilitator provides an opportunity for the next group to present their results followed by a question and answer session where the other groups are invited to make comments or give input to the presenting group.

7) The facilitator continues the learning process by asking the participants to simulate how the RSA and other parties will respond to the fire, and the flow of communication, coordination and reporting of the fire. This simulation is intended to invite the participants to think about what should be done in the case of a fire. The intention of the simulation is that each RSA and other stakeholders understand their duties and functions, and the importance of cooperation and coordination among the relevant parties. The facilitator can help participants to describe the plan using the following example:

8) The facilitator guides participants as they draw important learning points from the simulation session and then closes the session for Module III.
MODULE IV: TECHNIQUES FOR WELLBORE MAKING ON PEATLANDS

1. Objectives
In this fourth module, participants will learn about how to make a wellbore. The objective is for the participants to be able to manually make a well and use it as a source of water for fire prevention and control.

Participants will be provided with the following knowledge:
- An introduction to tools for making the wellbore
- Techniques for mechanical drilling and setting up pipes
- Techniques for maintenance and utilization

2. Target Participants
RSA members are the main participants targeted by this module.

3. Methodology
The methods used for this training Module include:
- Lecture using a PowerPoint presentation
- Demonstration and hands-on wellbore drilling practice in the field

Classroom sessions require a computer and LCD projector, while for the practice in the field, the activities need to be supported by the following tools and materials (clearly explained in the reading material):
- 1.5 inch wide PVC pipes with a max length of 20 m for each wellbore (5 pipes);
- 5 straight pipe connectors;
- Pipe glue (one tube) and white duct tape;
- Portable diesel powered water pump (Kubota GS / KS 160);
- Drill Bit;
- Drill pipes and connections (20 meters);
- 1 U-shaped pipe connector;
- 2 Pipe wrenches;
- Pipe clamp lock / vise;
- Hacksaw;
- A plastic hose to channel the water from the engine to the drill pipe;
- Other support tools such as machetes, hoes, shovels, axes, rubber tires, plastic/tarpaulin, buckets and large water bottles.

4. Process
Training Module IV will run for 45 minutes using the following process:
1) The facilitator opens the Module IV training session.
2) The speakers give a lecture on the technique for making the wellbore in peatland. Reading materials can be distributed before the lecture begins. The facilitator will guide a question and answer session during or after the lecture.
3) The facilitator then explains technical steps that will be carried out in the field before closing the session for this module.
4) During the field practice, a trainer will explain once again each type of equipment, its purpose, and steps in the drilling process. There should be sufficient time allocated for this.

*Capacity Building Training Module for a Community-Based Fire Prevention and Control System for Tropical Forests and Peatlands*