INTROP: Highlight

Forest Fire Management in Tropical Peat Swamp Forest

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Forest fire occurring in the tropical peat swamp forest has been a major concern and has been on the increase at an alarming rate during the past decades. This problem is further compounded by the fact that some of the affected areas have burned more than once. If left unabated, peat areas that will be at risk to frequent fire and more areas will be burnt. The burning of peat swamp forest has also caused regional haze occurring annually leading to numerous problems and uneasiness among neighbouring countries. This paper aims to review factors that lead to peat forest fire and discuss its impact on the ecosystem. Possible recommendations and suggestions will be presented on ways to reduce the problems.

INTRODUCTION

Tropical peatland covers 400 Mha (Maltby, 1997) of land area mainly in South east Asia. Peatlands especially tropical peat swamp forest can provide a wide range of goods and services such flood control, wildlife habitat and biological biodiversity (Maltby, 1997). One of its services that has gain a lot of attention is its role as a vast storehouse for carbon, estimated to be 70 Gt or up to 20 % of total soil carbon (Maltby, 1997). The widespread conversion of peatlands for agriculture and forestry activities has raised concern on the ability of the peatlands to plays its role as the storehouse for carbon.

One of the prerequisite to agriculture and forestry activities is to drain the peatlands which causes lowering of the water levels that lead to subsidence and also oxidation of the peat. The lowering of the water level also led to the drying of the peat making it easier to be ignited causing peat fires.

This paper aims to review factors that lead to peat forest fire and discuss its impact on the ecosystem. Possible recommendations and suggestions will be presented on ways to reduce the problems.

Peat Fire

Peat fire is classified as ground fire with a constant tendency of self-penetration (Artsybashev 1983). It occurs in subsurface organic fuels, such as duff layers under forest stands, arctic tundra/taiga and organic soils of swamps/bogs and peat (Brown and Davis 1973). They burn underneath the surface by smouldering combustion with no flame and little smoke and most often ignited by surface fire, depending on the moisture content of the organic layers (Pyne et al. 1996).

With further combustion, the fire penetrates (Artsybashev 1983) into the peat horizon of the soil, burning out funnel-shaped pits and then spreads in a horizontal manner. Since the root-holding layer of soil burns in a peat fire, trees are deprived of root support, and are uprooted with the tree crowns usually toppling in the burnt area.

Peat fire is dominated by smouldering combustion, the fire is self-sustaining at very low rates from a few decimetres to tens of metres per day (Artsybashev 1983) or for weeks at rates of less than 1.5 g per square meter per hour or 0.025 cm depth reduction per hour (Chandler and others 1983).

The factors that may affect the rate of peat burning are the moisture and inorganic content of the duff and its organic bulk density (Frandsen 1991). Both the moisture and the inorganic content hinder the smouldering process and therefore are viewed as slowing down the rate of burning. Increasing the bulk density may slow down the supply of oxygen to the combustion interface and also slow the rate of burning.

A 50 cm layer of peat in an area of 1 m^2 can produce 165000 kcal of heat in combustion even with a humidity of up to 500% (Artsybashev 1983). Smouldering ground fires can raise mineral soil temperature above 300°C for several hours with peak temperature near 600°C (Frandsen 1991), which can result in the decomposition of organic material and kill important soil organisms. At 120°C, peat will decompose and form CO_2, at 250 – 500°C intensive decomposition occur and form tar and gas. More than 850°C, it forms volatiles (hydrogen and methane gases).

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Factors Causing Peat Forest Fire

Fire has been traditionally used as a tool for clearing the area for agriculture for agriculture activities. It is very popular since it is low cost and very efficient in removing woody debris. However, the fire may get out of controlled and spread to the adjacent forest areas. This is one of the main factors causing forest fires in Penisular Malaysia.

Other factors causing forest fires are fires from campers who were hunting and fishing. High voltage electricity cable can also be a source for forest fires. The high voltage wire may produce spark and ignite the bush underneath the right of way of the electricity cable and this fire will spread to the adjoining swamp forest.

Impacts of Peat Swamp Forest Fire

In situ impacts of peat fire (Hadisuparto 1999) are significant included the loss of biomass and its species diversity, loss of peat resources, negative process of subsidence and lose of carbon sink function (Page et al 2002). Besides, the burning peat also contributed to smoke and haze dispersal that caused a serious health problem and transportation disturbances. The dense haze of 1997' fire episodes in Indonesia (Takashi and Shimada 1998) has affected peat swamp forest in Central Kalimantan with decreasing ground water level remarkably to 98 cm below the ground surface, decreasing the evapotranspiration of the forest to 50% of the normal year and decreasing solar radiation to about 40% of normal condition.

The presence of high concentration of total suspended particulate cause light scattering and reduction in visibility. The low visibility has led to closures of airports and cancellations of flights. River visibility in Borneo and marine traffic in the Strait of Malacca were disrupted (ADB, 2001). Study by Shahwahid and Jamal (1998) estimated that flight cancellations in the 1997 haze resulted in sales loss of US2.6 million to the Malaysian Airline System.

Fire Prevention Programme

As mentioned earlier in this paper, the main causes of peat swamp forest fires are from human activities. Therefore to reduce the incidences of fire occurrences is to create awareness among the local community around the forest on the importance of the peat swamp forest and the interdependence of the local community on the peat swamp forest. The local community should also be educated on the ecosystem services provided by the swamp forest such as storage for water, flood buffering effects and the carbon storage. These activities will raised the level of awareness among the community on the important roles played by the peat swamp forest and the ecosystem services provided by the peat swamp forest. This awareness will also motivate them to protect the peat swamp forest from fire.

The local community also needs to be educated on the nature of peat swamp forest fire and the damaging impacts of the forest fire towards the peat swamp forest ecosystem and also the regional impact of the fires such as haze.

In order to discourage uncontrolled forest fires, patrolling the area during dry months should be undertaken around the peat swamp forest area. The presence of forestry personnel will discourage illegal cutting of the forest for agriculture activities and also burning of debris. The National Forestry Act 1984, Amended 1993 has legal provisions on prosecuting offenders indicted of setting fires in the peat swamp forest areas under the permanent forest reserve. For the areas outside the jurisdiction of Forestry Department, Fire Services Act 1988, Section 62 can be used to prosecute person who commits offence of burning the forest areas.

In peat swamp forest under category of production forest where harvesting of trees are being carried out, canal are built to bring out the timber from the peat swamp forest. These canals also cause water to drain out of the peat swamp forest leading to the drying up of the peat (Ainuddin and others 2006). Unused canal after harvesting has stopped should be blocked to prevent the draining out of the water from the peat. This will ensure the water level of the peat swamp forest will be maintained at optimal level.

Control and Suppression Measures of Peat Swamp Forest Fire

Peat swamp forest fire spreads from surface fire to ground fire. In ground fire, the fire spreads slowly below the surface of the peat making it difficult to detect and extinguish. The only way to know the existence of the fire below the surface is by observing smoke coming up to the surface and by spraying water on top of the peat surface. The presence of fire will be indicated by the presence of steam formed from the sprayed water.

For a small surface fire occurring in the peat swamp forest fire with high water level, direct attack using handtools and water pump can be used to control and suppressed the fire. Small fireline can be constructed to prevent the fire from spreading into the unburned areas.

Once the fire has increase in its intensity and goes below the surface of the peat, the only effective way to control and suppressed peat swamp forest fire is by total flooding. In this technique, the burning peat swamp forest area will be comparmentalised into small area by opening and closing network of canals. The area will be flooded using high powered and high capacity water pumps and causing the water level in the peat swamp areas. As the water level increases, the peat moisture level increases, extinguishing the underground peat swamp forest fire.

Post Fire Activities

In the burnt peat swamp forest areas, grasses such as *Imperata cylindrica* and ferns such as *Glychenia spp.* will be rapidly colonised the area and suppressed the regeneration of trees. This condition will encourage recurrent fires since the burnt areas are open and become flammable during the dry period. Rehabilitation of the burnt areas with fast growing indigenous species must be undertaken to ensure the area is suitable for natural regeneration of the forest.

Rehabilitation of degraded burnt peat swamp forest can be done through planting of indigenous species. Species which has the best growth potential as recommended by Nuyim (2003) to be used for rehabilitation are, *Eugenia oblata, Melaleuca cajuputi, Alostnia sphathulata* and *Calophyllum sclerophyllym*. These species can grow up to 60 cm/year in height.

CONCLUSION

The recurrent fires in peat swamp forest have degraded the area and limit the function of the ecosystem. In order to protect the area from further degradation, more efforts should be taken to put in place fire prevention programmes. The fire prevention programmes will help to educate the local community on the importance of peat swamp forest ecosystem and also understand the impact of forest fire to the ecosystem. Post fire activities such as rehabilitation should be undertaken to improve and regenerate the degraded peat swamp forest. Prevention is better than cure

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