Controlled burning in peat lands owned by small farmers: a case study in land preparation

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Abstract

The 1997/1998 forest fires in Indonesia resulted in the destruction of at least 10 million ha of forests and non-forestslands and the release of more than 2.6 G tons of carbon. These fires made Indonesia one of the largest contributors of greenhouse gases in the world. It is now recognized that about 80–90% of the fires came from agricultural and industrial plantation estates using fire for land preparation activities. Estate oil palm development accounted for the majority of the fires, particularly in Riau. At least 176 companies accredited with the Indonesian Forestry and Estate Crops Department caused the fires in 1997/1998. More than 50 companies in 1999 and 100 companies in 2001 were identified to be still using fire in land preparation activities. To make matters worse, the use of fire in land clearing is also prevalent among many small-holder farmers as a traditional means of land preparation. Since 2000, some companies using fire for land preparation have been taken to court and been punished. Meanwhile, shifting cultivators still have the possibility of using fire as long as the impact is not so bad. In order to understand the behavior and characteristics of fire in land preparation by small-holder farmers, several peat fire experiments were conducted. The experiments showed that high flame temperature and intensity result from high fuel loads. Such information is important in order to evaluate land preparation practices with the use of fire, to determine restoration methods, and to recommend appropriate policy reforms for small-holder farmers.

Introduction

Human activity is the major agent causing stratospheric ozone depletion, global warming, deforestation, acid precipitation, extinction of species, and other changes that have not yet become apparent (Levine 1996). These changes are caused, and significantly enhanced, by biomass burning. Biomass burning is the burning of the world’s living and dead vegetation, including grasslands, forests, and agricultural lands following harvest for land clearing and land-use change (Levine 1996). Biomass burning is a significant global source of gaseous and particulate emissions to the atmosphere.

Fire risk is increased dramatically by the conversion of forests to rubber and oil palm plantations, and by the logging of natural forests, which opens the canopy and dries out the ground cover. Plantations are drier, and trees are move evenly spaced than natural tropical moist forests, thus increasing opportunities for fire to spread. Evidence also suggests that fires burn most easily in secondary forests that have already been disturbed during (frequently illegal) timber operations. Selective
logging destroys much of the undergrowth and the closed canopy that previously reduced the likelihood and impact of forest fires in natural forests (EEPSEA and WWF 1998). Unfortunately, small land holders have been blamed for causing most of the smoke releases (Fagi et al. 1997). Traditional slash-and-burn has been used successfully for centuries and is an integral part of farming and land clearing techniques in the tropics. The answer to controlling smoke and haze that fires produce is not to ban burning outright but to regulate it, expand technological options, and make policy changes that will prevent another environmental disaster the next time there is a long dry season (Fagi et al. 1997).

A large fire in 1994 destroyed 5.11 million ha of forest, causing the Indonesian government to declare a no burn policy in June 1995. Unfortunately, the policy has not worked well because it has not been supported by field guidelines or practical implementation and there are no clear sanctions to be applied for companies that do not obey the policy. In 1997/1998 about 10 million ha of forest in Indonesia were destroyed, mostly by arson.

In early 2000 the government again pushed the idea of a no burn policy accompanied by law enforcement to minimize smoke production during the dry season. This was mainly applied towards large companies as it was difficult to apply to small farmers. To solve the small farmer problem, controlled burning through fuel management and modifications in burning techniques may be possible solutions to minimize the impact to the environment.

Methods

Research was conducted from August 2001 until July 2002 in peatland belonging to the Pelalawan village, Pelalawan sub-district, Pelalawan district, Riau Province, Indonesia (102°00′–102°28′E and 00°10′–00°40′N). Total peat area in this site was 5362.5 ha. The research site was dominated by shrubs and ferns such as Shorea macrophylla, Macaranga pruinosa, Ficus sundaica, Stenochlaena palustris, Parastemon urryllus, Baccaurea pendula, Nephrolepis flaccigera, and Gleichenia linearis. The area has a tropical climate with annual rainfall ranging between 2500–3000 mm and daily temperatures between 22 °C and 31 °C. According to data from the Meteorological and Geophysical Agency, Ministry of Transportation, rainfall between January–December 2001 was 3794.5 mm with 86 rainy days.

There are three different kinds of peat covering the study site: fibric, hemic, and sapric. The fibric peat type has a low level of decomposition, low humus, and very low nutrition protection capacity. Due to these factors, fibric peat is a poor media for agricultural activity. Fibric peats also possess a high porosity which allows rapid water penetration. Hemic peat has a moderate level of decomposition and consists of several humic materials giving it better nutrition protection capacity than fibric peat. Hemic peat provides a good media for agricultural activity as long as the peat has a high content of humic materials. Sapric or mature peat has a high content of humus and also is very good in mineral protecting. Peat land acidity in the site was very acid, with a pH range between 3.0–3.7.

Activities conducted before burning

Four plots of 0.04 ha (20 m × 20 m) each were established in sapric peat. Each plot was surrounded by 1-m wide and 1.5-m deep canal. Water in the canal could be controlled and used to saturate the peat when burning was conducted. All vegetation found in the plots (shrubs, seedlings, saplings, poles, and trees) was cut down (slashed) and spread out. Logs with diameters of more than 10 cm were pushed out of the plots. Following slashing, the material was allowed to dry for 3 weeks as it is usually done by small farmers in Riau.

Three 2 m² (2-m × 1-m) subplots were chosen in each plot. Living and dead plant material in the subplots was collected by destructive sampling, dried, and weighed. Fuel load on a dry weight basis was estimated after slashing and before burning.

Three 100 g samples of each of the materials (litter, leaves, branches, and logs) found in each subplot were taken and used for moisture content measurement. Samples were dried for 48 hours at 75 °C (Clar and Chatten 1954). Fuel moisture content was estimated through dry weight basis. Fuel bed depth was measured by the average height of dried fuel spread out in the subplot. Measurements were taken at five locations in each subplot.