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HIGHLIGHTS

CONTROL BEFORE IT GROWS: MICROCLIMATE AND FOREST PLANTATION FIRE

Ruzana Sanusi[1,2*]
[1]Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia, 43400 UPM Serdang, Selangor
[2]Faculty of Forestry, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor

*ruzanasanusi@upm.edu.my

INTRODUCTION

Forest plantation is an area with planted trees that will be harvested and aimed for the direct or indirect use for human needs (Borges et al., 2016). Due to an increase in the demand for timber, many forest plantations are established and, in many cases, fast growing species such as pines and eucalypts are used and even being planted besides their native setting (Rivera, 2017). According to Payn et al. (2015), planted forest areas throughout the world has increased from 167.5 million ha in 1995 to 277.9 million ha in 2015 with the increase varies according to the region and climate condition.

Alteration of the natural landscape to these forest plantations leads to the changes in vegetation structure, thus affecting its microclimate conditions. Changes in microclimate conditions added with climate change effect, influence the rainfall patterns that consequently may influenced fire occurrence (Mann et al., 2016). Significantly, beyond the wood production from forest plantations, it is highly expected that the plantations are managed in a way that they will enhance ecosystem services such as microclimate mitigation (Pawson et al., 2013; Paquette and Messier, 2010) thus reduces fire occurrence.

MICROCLIMATE AND FOREST PLANTATION SUSCEPTIBILITY TO FIRE

The risk of the planted forest will increase mainly from direct climate events such as the occurrence of storm, but the risk will also increase in case of fire (IPCC, 2014). PAR is the best predictor of fire spread and its influence on flammability is directly and indirectly linkable to other microclimate parameters such as solar radiation, relative humidity and rainfall (Just et al., 2016). In addition, the interception of PAR or solar radiation is greatly dependent on the tree canopy cover and tree height as these are the factors that influence the understory light (Martens et al., 2000). The canopy cover and tree characteristics determine the solar radiation penetration below the canopy thus can influence the microclimate of the area as well as the vegetation on the ground. Moreover, this will consequently be affecting the soil moisture conditions of the area. The combination of the alteration of the surrounding areas extreme weather events such as heat waves and drought will eventually expose these planted forest areas to the risk and disturbances from fire events.

In significance, the forest plantation susceptibility to fire is due to the plantation is habitually characterized by areas covered with grass, weeds or bushes that are highly flammable especially in dry conditions and more vulnerable for plants in the age of less than five years (FAO, 1993). Moreover, dense forest plantations occupied with fast growing, highly flammable species such as pines and eucalypt that are mainly planted for commercial purposes, prone to develop high intensity and severe large fires (Fernandes et al., 2016). Consequently, this may be a threat to economic, biodiversity (van der Werf et al., 2010), society and the timber industry, especially if it is exacerbated with frequent and severe drought events (Gómez-González et al., 2018). For instance, fire events such as the Black Saturday fires that had happened in Australia in 2009, where approximately 30 kha of a rugged landscape extensively afforested with eucalypt and pine plantations were burned that consequently affected many lives (Gómez-González et al., 2018).

Worryingly, there is an increasing trend in the conversion of many areas in tropical countries to Eucalyptus plantations for pulp production (Vasconcelos et al., 2019). The establishment of this fast growing species in many tropical regions may be an indication that more suitable, specific and intensive strategies should be planned for forest plantations as the preparation in reducing the risk of fire occurrence and disturbance.

MICROCLIMATE AND FIRE MITIGATION STRATEGIES FOR FOREST PLANTATION

Fire events can disturb the dynamic equilibrium of an area and consequently will not only be a liability to human lives but also can damage the surrounding infrastructures and increase air pollution (White et al., 2015). The microclimate mitigation strategies are especially important for forest plantations that are located close to highly urbanized areas. The urbanized areas are regularly characterized with hotter and drier conditions as well as an increase in wind speed. This will be an influential factor in the increase of fire risk not

only to the urban areas but also to the forest plantation as well. This risk can be mitigated through the increase in tree canopy covers throughout the urbanized areas that can strategically improve the microclimate conditions (Li & Song, 2019; Sanusi et al., 2016).

On the other hand, for the management of forest plantation, the silvicultural activities applied to the planted forest can determine the influence of fire disturbance. For instance, according to a study by Cruz et al. (2017), pruning and thinning activities had significantly changed the plantation fuel complex and affected the fireline intensity where it was recorded that the thinning reduced signified fire intensity during Very High Fire Danger days.

Several other strategies for microclimate and fire mitigation are designing road and firebreaks in for the forest plantation, removing the weed and grass as well as establishing intercropping of plants in between the main tree crops (FAO, 1993). Litter on the Eucalyptus plantation floors may act as a protective barrier against erosion, but the removal is important to reduce fire hazard (Bayle, 2019). In addition, the surrounding communities and other stakeholders should also be encouraged to participate in the microclimate and fire mitigation strategies. The land managers, if possible, extinguishing the fires as soon as it started (Rivera, 2017) and increase in awareness among local people surrounding the forest plantation area are usually preferable and can reduce the impact of fire events (FAO, 1993).

Moreover, fire alert is one of the beneficial strategies for early warning of the potential occurrence of fire events. This fire alert will be a powerful tool for fire prevention strategy as it evaluates and predicts the fire susceptibility possibility daily through the consideration of the weather conditions of an area (White et al., 2015). By determining the fire alert, it serves as an important warning for the communities that surround the affected areas and better management and planning can be made for forest plantation and human protection.

In addition, diversity and discontinuity of landscapes and infrastructures surrounding the areas to hinder fire progression that consequently will decrease the spread of fire to other areas (Ferreira et al., 2015). In significance, before the establishment of forest plantation, the fire ecology context should be put into consideration to ensure the success of fire management planning and improvement in regulation and science-based management policies are strongly needed so that the effectiveness of the planned strategies can be optimized (Gómez-González et al., 2018).

The forest plantations are particularly vulnerable to fire events as well as the growing importance for the forest plantations to be capable in providing various ecosystem services. Therefore, in ensuring the continuation forest plantation contribution to the ecosystem services primarily for the mitigation of microclimate and consequently reducing fire occurrences, climate adaptation strategies should be developed, and forest health must be the main focus for the plantation as well as more research in these areas should be established (Payn et al., 2015).

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