Forest fire, a complex biophysical process

Environment

Forest fire is a complex biophysical process with numerous direct and indirect effects on the atmosphere, the hydrosphere, and the biosphere. Moreover, in some fire-prone environment, fire disturbance is an essential part of maintaining the ecosystem (Verma and Jayakumar 2015, 2018). Fire is a key factor that determines the forest diversity and dynamics of vegetation (Bajocco et al. 2010). A forest fire is an ecological oxymoron, it can disturb fauna and flora, sometimes also involves villages structures and cause wide-ranging environmental damage, conversion understory vegetation structure (Rojas-Sandoval and Acevedo-Rodríguez 2014; Hoffmann et al. 2012; Brooks et al. 2004) on the other hand as a natural phenomenon, it is linked to the dynamics of many plant communities.

Many species of trees can withstand and thrive from the periodic low intensity burns that have historically affected them (Verma and Jayakumar 2015, Verma et al. 2017). A forest fire is a ferial attribute in forests every year, causing incalculable detriment to the forest splendor, forest ecosystem as well as forest composition, structure (Cochrane and Laurance 2002). But it can also be most beneficial for plant regeneration, nutrient recycling and natural processes initiating natural exercises of forest vegetation successions (Rowell and Moore 2000).

Forest fire is recognized as a major conductor of the global change in terrestrial ecosystems (Rudel et al. 2005). Forest biomass burning is the second largest source of trace gases in the global atmosphere (Crutzen and Andreae 1990; Bond et al. 2004) and severity influence global climate change (Crutzen et al. 1979; Olson et al. 1983). Consequently, forest fires are able to alter the carbon cycle at regional or even global scales (Narayan

et al. 2007), as well as to decrease the effect of carbon sequestration by forest ecosystems (Van Der Werf et al. 2006; Wiedinmyer and Neff 2007).

Fire release large amount of greenhouse gases as well as other trace gases such as carbon monoxide, methane, hydrocarbons, nitric oxide and nitrous oxide etc. into the atmosphere (Seiler and Crutzen 1980). Carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) are the significant greenhouse gases that contribute towards the global warming at 60%, 15%, and 5%, respectively (Watson et al. 1996). Concentrations of these greenhouse gases in the atmosphere are increasing at 0. 4%, 3. 0% and 0. 22% per year, respectively (Battle et al. 1996).

In India forest fire are mostly anthropogenic- accidentally, negligently, and intentionally. Clearing the land for shifting cultivation in the north-east region of India (Singh and Singh 1987) and collection of the non-timber forest products such as collection of Tendu leaves in Central India are the major reasons of forest fires. The normal forest fire season in India starts from the month of February to June. Ranjan and Upadhyay (1999) reported that each year 1. 9–3. 6 ´ 106 ha land of primary close forests is cleared under shifting cultivation. Shifting cultivation practice has cleared 0. 05 Mha of forest area every year in the northeastern states of India, and totally, 17. 22 Mt wood biomass and 10. 69 Mt C was removed at the rate of 1. 72 Mt and 1. 07 Mt C yr−1, respectively (Manhas et al. 2006).

There are no comprehensive studies with respect to the burnt area, fire incidences, amount of biomass burnt and carbon emissions in vegetation types of Madhya Pradesh, India. In the present work of estimating burnt area

and carbon emissions from forest vegetation fire has been taken in order to assess the amount of greenhouse gases released between 2002 and 2016, in Madhya Pradesh, India. Most biomass burning emission studies trust on the model developed by Seiler and Crutzen (1980), which combines information on above-ground biomass available for burning, burning area, combustion factors, and emission factors for a certain gas species and vegetation type, to calculate the pyrogenic emissions (Wooster et al. 2005).