Chapter 2

Effect of Climate Change on Tropical Dry Forests

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ABSTRACT

Around 1.6 billion people in the world are directly dependent on forests for food, fodder, fuel, shelter, and livelihood, out of which 60 million are entirely dependent on forests. Forests silently provide us with ecosystem services such as climate regulation, carbon sequestration, harbouring biodiversity, synchronizing nutrient cycling, and many more. Tropical Dry Forests (TDF’s) occupy around 42% of total forest area of the tropics and subtropics and facilitate sustenance of world’s marginalized populations. Change in vegetation composition and distribution, deflected succession, carbon sequestration potential, nutrient cycling and symbiotic associations would affect TDF at ecosystem level. At species level, climate change will impact photosynthesis, phenology, physiognomy, seed germination, and temperature-sensitive physiological processes. In order to mitigate the effects of climate change, specific mitigation and adaptation strategies are required for TDF that need to be designed with concerted efforts from scientists, policy makers and local stakeholders.

INTRODUCTION

Forests are complex ecosystems that have a delicate balance of biotic and abiotic components that interact, influence, modify and adapt to each other. The term forest is a very widely used but an ill-defined term and globally there are around 800 ways in which forests have been defined (Lund, 2012). The Food and Agricultural Organization (FAO) defines forest as a ‘land spanning more than 0.5 ha with trees higher than 5m and a canopy cover of more than 10%, or trees able to reach these thresholds in situ’ (FAO, 2010). According to the Intergovernmental Panel on Climate Change (IPCC) forest is defined as vegetation type that is dominated by trees, and is defined in different parts of the world according to the variation in biogeophysical conditions, social structure and economics of the region (IPCC, 2014). Of the many parameters used to define forests such as type of vegetation, physiognomy, species composition, canopy cover is considered to be an important parameter. The way a country defines its forests largely

depends upon the vegetation type, physiognomy, forest structure, ownership of land, and economic use. In Australia, the canopy cover of typical forest should be greater than 20% of the total area, whereas in South Africa the value should be greater than 60% (Reddy et al., 2013). In India, the Forest Survey of India (FSI) defines forest as ‘all lands more than one hectare in area, with a tree canopy density of >10%, irrespective of ownership and legal status’ (FSI, 2011). This means that regardless of the nature of the tree cover, whether it is natural or planted, or the trees species are alien or native, any area having a minimum tree cover density of 10% is a forest. Based upon canopy density, forests in India have further been classified into five classes namely; Very Dense Forests, moderately dense forests, Open forests, Scrub and Non-forest (ISFR, 2017). Classification of forests has received much attention in the past and there have been several classification systems based upon climate, vegetation type, physiognomy and floristics. The system of life zones was the first forest classification system based on climate (Holdridge, 1947). Mueller-Dombois & Ellenberg (1974) proposed a classification system that laid emphasis on physiognomy of vegetation. Westhoff & van der Maarel (1978) integrated floristics and physiognomy to classify forests. Champion & Seth (1968) recognized four major climatic zones in India that harbours 16 major forest types comprising 221 minor types. On the basis of species associations and bioclimate, Gadgil Meher-Homji (1986) defined 42 forest types in India. Recently, Reddy et al. (2015) used IRS resourcesat-2 advanced wide field sensor to classify forest and scrub types. Seventeen percent of the global standing tropical forests are represented by tropical dry forests (UNEP, 2011). Irrespective of their type, forests across the world are under threat due to global climate change (Deb et al., 2018).

**CLIMATE CHANGE**

Climate change is one of the most serious environmental threats faced by the world today. It was recognized as a significant global environmental challenge a couple of decades back. International efforts to address this issue began with the establishment of the Intergovernmental Panel on Climate Change (IPCC) by the World Meteorological Organisation (WMO) and United Nations Environment Programme (UNEP) in 1988. IPCC defines climate change as a ‘change in climate over time, whether due to natural variation or due to human induced activity’ (IPCC, 2001). This definition differs from that of the United Nations Framework Convention on Climate Change (UNFCCC), which refers to climate change as “change in climate attributed only to anthropogenic activities which is in addition to the natural climatic variability observed over comparable time periods” (UNFCCC, 1992). UNFCCC was adopted in 1992, with an objective of stabilizing the concentration of greenhouse gases (GHG) in the atmosphere.

Factors that cause or contribute to climate change are known as ‘climate forcings’ that can be either natural or anthropogenic. Natural factors include volcanic eruptions, alteration in sun’s intensity, and very slow changes in the oceanic circulation or land surface. Anthropogenic activities are fossil fuel combustion, industrial activities, emissions from agricultural systems and waste decomposition. In the fifth assessment report the IPCC has stated that anthropogenic climate change is very much real and is bound to have widespread impacts on natural systems. The report also says that each of the last three decades have been successively warmer than any preceding decade since 1850, and the period from 1983 to 2012 has been warmest 30-year period in the last 1400 years in the northern hemisphere. Rise in the global mean surface temperature may reach up to 4.8°C by the end of the 21st century, whereas maximum increase is predicted in the Polar Regions (IPCC, 2014). In addition to rise in temperature and disturbed precipitation patterns, global climate change will also increase the frequency of extreme events such as