Chapter 18
Silviculture of Dry Deciduous Forests, India

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Abstract The dry deciduous forest is the most extensive forest type of India and exhibits a wide range in structural and functional attributes in response to marked spatial variation in soil and climatic conditions. Two subgroups, southern and northern, are clearly distinguished. The climax types under the southern subgroup are teak (*Tectona grandis*) forests, red sander (*Pterocarpus santalinus*) forests, and mixed forests without teak, and those in the northern subgroup are sal (*Shorea robusta*)-bearing forests, and mixed forests without sal. The most common species in the southern types are *Tectona grandis*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Boswellia serrata*, *Emblica officinalis*, *Acacia leucophloea*, *Bridelia retusa*, *Wrightia tinctoria*, *Pterocarpus marsupium,* etc. In the northern subgroup, main associates of sal are *Anogeissus latifolia*, *Buchanania lanzan*, *Terminalia tomentosa*, *Emblica officinalis,* and *Lannea coromandelica*. These forests are under-stocked and lack natural regeneration on account of excessive grazing, trampling, firewood removals and recurrent fire.

Keywords Basal area · Biomass · Biotic interferences · Coppice · Coppice rotation · Degradation stages · Dry forest · Felling cycle · Fodder trees · Grazing · Growing stock · Increment · Natural regeneration · Nontimber forest products · Nutrient conservation · *Shorea robusta* · *Tectona grandis* · Working circle

18.1 Introduction

The dry deciduous forests in India occur in the rainfall zone between 750 and 1,500 mm with a long dry season extending over 6–8 months. The greater part of the rain falls during July to September. The maximum summer temperature may be as high as 48°C and the minimum −2.2 to 6.1°C. This type of forest occurs in Utter Pradesh, Bihar, Orissa, Punjab, Haryana, Madhya Pradesh, Gujarat, Maharashtra, Madhya Pradesh, Karnataka, and Tamil Nadu (Fig. 18.1). Dry forest once covered

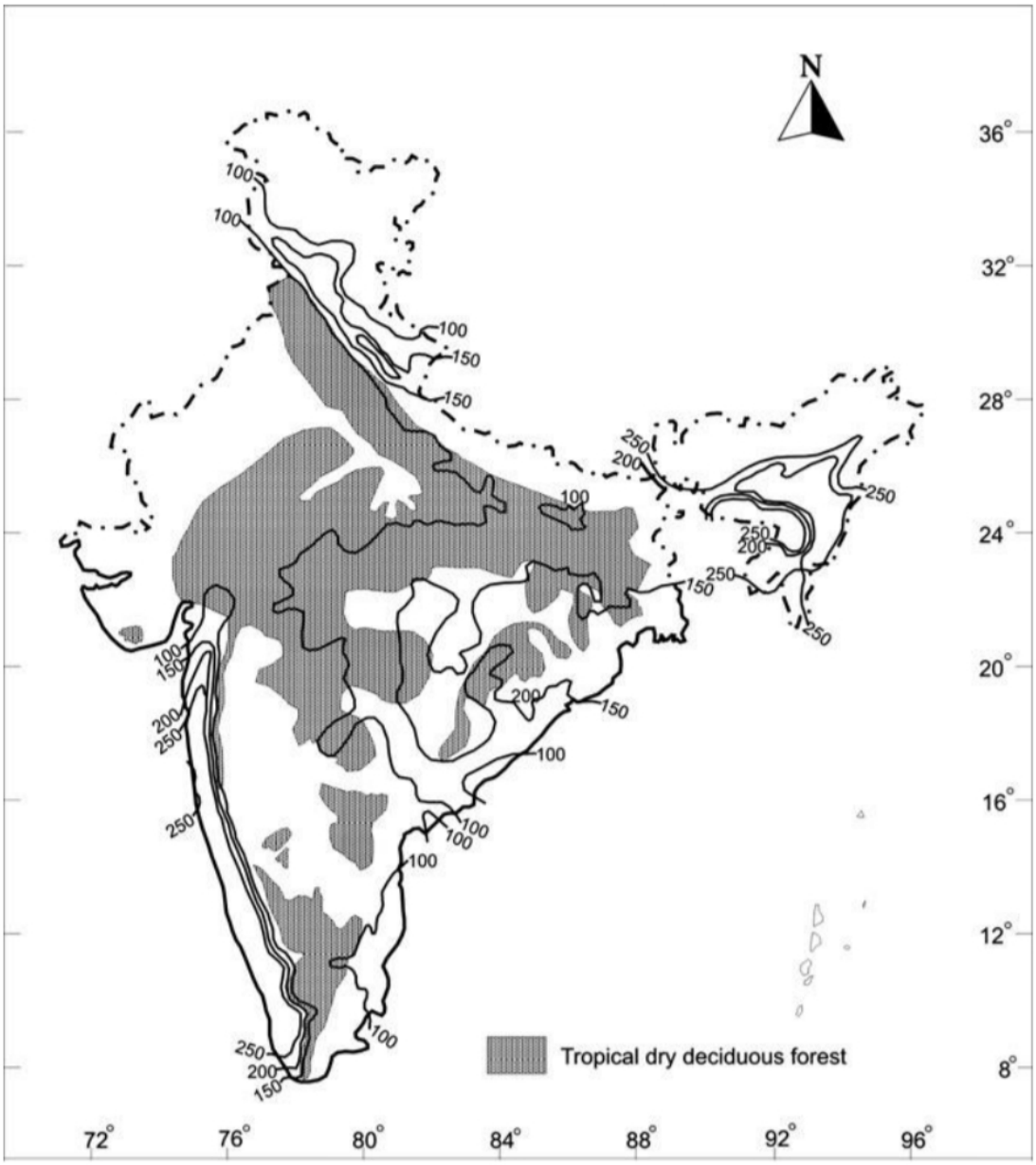

Fig. 18.1 Potential distribution of tropical dry deciduous forest in India. The *contour lines* represent annual rainfall in centimeter

more than half of the area (about 170 million ha) of the country. However, on account of population pressure, the dry forests now cover only around 26–27 million ha.

Two subgroups, southern and northern, are clearly distinguished under this broad formation (Champion and Seth 1968a). The climax types under the southern subgroup are (1) teak (*Tectona grandis*) forests, (2) red sander (*Pterocarpus santalinus*) forests, and (3) mixed forests. The most common species in the southern types are *Tectona grandis*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Boswellia serrata*, *Emblica officinalis*, *Acacia leucophloea*, *Bridelia retusa*, *Wrightia tinctoria*, *Pterocarpus marsupium,* etc. Apart from teak (*Tectona grandis*), some of the valuable species like *Santalum album* and *Pterocarpus santalinus* are found in these forests. The most common bamboo is *Dendrocalamus strictus*. The northern subgroup is divided into two types (1) sal (*Shorea robusta*)-bearing forests; and (2) mixed forests without sal. Main associates of sal are *Anogeissus latifolia*, *Buchanania lanzan, Terminalia tomentosa, Emblica officinalis* and *Lannea coromandelica*. In the mixed type, species composition is essentially the same, except that sal is absent. Several edaphic climax types and seral stages have been recognized within the two subgroups (Table 18.1) and these are described in detail by Champion and Seth (1968a).

The forests are subjected to severe biotic interferences, particularly fire and grazing. These forests supply about 80–95% of fodder needs of the livestock

Table 18.1 Tropical dry deciduous forest types of India (based on Champion and Seth 1968a)

Southern tropical dry deciduous forests		Northern tropical dry deciduous forests
Dry teak bearing forest		Dry sal-bearing forest
Dry teak forest		Dry Siwalik sal forest
Very dry teak forest		Dry plains sal forest
Dry red sanders bearing forest		Dry peninsular sal forest
Southern dry mixed deciduous forest		Northern dry mixed deciduous forest
Degradation stages	Edaphic types	Seral types
Dry deciduous scrub	Anogeissus pendula forest	Dry tropical riverain forest
Dry savannah forest	Anogeissus pendula scrub	Khair (Acacia catechu)-sissoo (Dalbergia sissoo) forest
Dry grassland	Boswellia forest	Inundation babul (Acacia nilotica) forest
Euphorbia scrub	Babul (Acacia nilotica) forest	Secondary dry deciduous forest
	Hardwickia forest	
	Butea forest	
	Aegle forest	
	Laterite thorn forest	
	Saline/alkaline scrub savannah	
	Phoenix savannah	
	Babul (Acacia nilotica) savannah	
	Salvadora-Tamarix scrub	
	Dry bamboo brake	

and 81–100% of fuelwood needs (Singh and Singh 1992a). A total of 76–89% of herbage is consumed by animals through free-range grazing (Pandey and Singh 1992). Productivity is low and far exceeded by removals, causing degradation. Degradation stages of dry deciduous forest can be compared with Savanna woodland (see Table 18.1). Here vegetation consists of broken soil cover, trees 3–6 m high including some trees having many stems from the base. The grasses occur throughout. Fire-resistant trees persist, either slowly establishing themselves as trees or sending up annual shoots from woody root stock. Thorn forests where Acacias predominate can be compared with "Tree savanna." Here locally consociations of certain species are predominant, notably *Acacia planiforns*, *Acacia Senegal,* and *Prosopis spicigera*. Thorn forests on degradation due to biotic factors resemble "Scrub savanna." *Zizyphus* scrub is common throughout intermingled with Euphorbias which are more conspicuous in rocky areas due to intense biotic pressure. On semiarid or arid saline/alkaline soils, *Salvadora* scrub is met with. At places, *Cassia auriculata,* which coppices very well, is left as residual vegetation almost in pure patches.

Small leaf size, medium leaf texture, rough bark texture, and medium deciduousness characterize the dry deciduous forest vegetation (Sagar and Singh 2003). These forests occur on nutrient-poor soils and show several strategies of nutrient conservation, e.g., nutrient immobilization by litter microbes (Singh et al. 1989), and substantial withdrawal of nutrients from the senescing leaves (sufficient to meet the demand of next generation of leaves) (Lal et al. 2001a, b) which enable them to cope with nutrient poverty. The canopy is renovated toward the end of the dry hot period enabling the plants to take full advantage of the ensuing short rainy season for biomass generation and growth (Singh and Singh 1992b). Because of the great variety of community types, soil and climatic conditions within the dry forest zone, these forests exhibit a wide range in structural and functional attributes. Basal area (trees + shrubs) ranged between 9 and 15 m^2 ha^{-1}, total biomass (trees + shrubs + herbs) from 53 to 94 ton ha^{-1}, and total net production (trees + shrubs + herbs) from 11 to 19 ton ha^{-1} $year^{-1}$ among three sites in an area experiencing 800 mm annual rainfall (Singh and Singh 1991).

Production of fuelwood, small timber, and other nontimber forest products (NTFPs) is the main objective of management and these forests primarily cater to the local demand. Firewood, bamboo, tendu (*Diospyros melanoxylon*) leaves, sandal (*Santalum album*) wood, red sanders, fruits and seeds, medicinal plants, and spices, etc. are important products. According to one estimate, NTFPs from these forests contribute 77% of the net value of forests, with the net present value of revenues from NTFPs being US $1,016–1,348 ha^{-1}, significantly higher than the returns from alternate land uses (Mahapatra and Tewari 2005). If use, option, and existence value are all taken into account, the total present value of nontimber goods and services available from a tropical deciduous forest in India varies from a minimum of US $4,034 to a maximum of US $6,662 ha^{-1} (Chopra 1993).