



# Indian Forests: Sustainable Uses and its Role in Livelihood Security

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## Abstract

Forests in India perform an important role in the economic and sociocultural life of the tribal people who live in and around the forests, as they support rural livelihoods and food security. India has a wide variety of forest types, including tropical evergreen, semievergreen, moist deciduous, dry deciduous, subtropical montane, temperate, alpine scrub, and mangrove forests, and the dominant plant species includes both deciduous and evergreen tree species like *Shorea robusta*, *Tectona grandis*, *Duabanga grandiflora*, *Mangifera Indica*, *Terminalia myriocarpa*, *Diospyros melanoxylon*, *Pterocarpus marsupium*, *Butea monosperma*, and *Madhuca longifolia*. Timber, fodder, fuelwood, and other variety of nontimber forest products (NTFPs) including wild edibles, oilseeds, medicinal plants, different types of resins, spices, fibres, and a variety of construction materials like bamboo, rattans, palms, and grasses are the most commonly extracted forest products of economic significance. Overgrazing and overexploitation of essential plant resources, as well as a lack of awareness and scientific understanding about plants and their harvesting, represent serious dangers to the existing plant populations of economically important plant species. The collection of rare and endangered plant species from natural settings for diverse experimental reasons, along with the natural enemies including pests and diseases, invasive weeds, and unsustainable harvesting for various economic and

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livelihood purposes, poses a threat to the existence of the wild population. Recognizing the ongoing depletion of these precious resources, proper management strategies should be undertaken to satisfy the growing demand and ensure their long-term viability for livelihood security and economic upliftment.

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**Keywords**

Forest goods and services · Forest policies · Livelihood security · Indian forests

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### 23.1 Introduction

India is one of the world's 17 mega-biodiversity nations and the Indian subcontinent hosts four biodiversity hotspots with high endemism and ever-increasing human pressure leading to habitat loss (Saikia and Khan 2018). Forests are the second-largest land use after agriculture, accounting for 21.67% of the country's total geographical area (FSI 2019). The rainforests of the Western Ghats, Andaman and Nicobar Islands, and northeastern states, the coniferous hill forests of the Himalayas, and the desert scrub and thorn forests of Rajasthan and Gujarat are among India's forest types due to its diverse geographical, climatic, and edaphic conditions (MoEFCC and World Bank 2018; Reddy et al. 2015; Singh and Chaturvedi 2017a, b). Tropical dry deciduous forests cover the most land area. They are found in large parts of the Central Highlands and Deccan Plateau in central and southern India. In contrast, tropical moist deciduous forests cover the second most land area and can be found in all regions except the Himalayas and drier parts of northern and western India (Reddy et al. 2015) (Table 23.1).

Forests help to provide sustainable farming by stabilizing soils, regulating climate and river flows, and sustaining water quality, flood control, pollination, disease biological control, and overall forest productivity (Bahuguna and Bisht 2013). Forests not only help in driving sustainable development but also act as a natural stabilizing agent for climate change by regulating the global carbon cycle significantly (Krishnan et al. 2020). Degradation of forests is due to anthropogenic and natural causes like overexploitation of forest resources, lack of scientific information on current population status and exploitation, habitat alteration, and uniqueness, a limited distribution range, overgrazing, attack by pathogens, herbivores, and seed predators lead to biodiversity loss, survival pressure over fragile ecosystems, soil fertility loss, land degradation, erosion, and excess water runoff into the lowlands (Kumar and Saikia 2020a). India has formulated and implemented several policies, and programs with implications on carbon sink, forest management, and biodiversity conservation (Ravindranath et al. 2008) for the preservation and protection of forests in India.

Forests are essential for ensuring livelihood security to the forest-dependent tribal communities from generation after generation and simultaneously, protecting them from further natural and anthropogenic degradation (Roy 1982). Sustainable management of natural forests helps in reducing poverty and escalating economic growth

**Table 23.1** Major Forests groups and type groups of India (Sources: Champion and Seth 1968; Singh and Chaturvedi 2017a, b)

Major forest groups	Forest type groups	Distribution	Dominant species
Moist tropical forests	Group 1: Tropical wet Evergreen forests	Maharashtra, Karnataka, Tamil Nadu (TN), Kerala, Andaman, West Bengal (WB), Assam, Odisha, and throughout northeast (NE) India	<i>Dipterocarpus grandiflorum</i> , <i>D. costatus</i> , <i>Hopeaodorata</i> , <i>Shorea assamica</i> , <i>Artocarpus chaplasi</i> , <i>Mesuaferrea</i>
	Group 2: Tropical Semievergreen forests	Maharashtra, Goa, Karnataka, Kerala, Andaman, Assam, WB, Odisha	<i>Xylia xylocarpus</i> , <i>Terminalia paniculata</i> , <i>T. tomentosa</i> , <i>Schleichera oleosa</i> , <i>Syzygium</i> spp., <i>Cinnamomum</i> spp.
	Group 3: Tropical moist deciduous forests	Madhya Pradesh (MP), Chhattisgarh, Maharashtra, Karnataka, TN, Kerala, Andaman and Nicobar, Uttar Pradesh (UP), Bihar, Odisha, WB, Assam	<i>Tectona grandis</i> , <i>Terminalia</i> spp., <i>Pterocarpus marsupium</i> , <i>Schleichera oleosa</i> , <i>Shorea robusta</i> , <i>lagerstroemia</i> spp.
	Group 4: Littoral and swamp forests	In coastal regions of WB, Odisha, Andhra Pradesh (AP), TN, and Gujarat	<i>Manilkara littoralis</i> , <i>Casuarina equisetifolia</i> , <i>Rhizophora mucronata</i> , <i>R. candelaria</i> , <i>Avicennia alba</i> , <i>Ceriops roxburghiana</i>
Dry tropical forests	Group 5: Tropical dry deciduous forests	MP, Gujarat, Maharashtra, AP, Karnataka, TN, Punjab, UP, Bihar, Chhattisgarh, Jharkhand, Odisha	<i>S. robusta</i> , <i>T. grandis</i> , <i>Anogeissus latifolia</i> , <i>T. tomentosa</i> , <i>Buchanania lanzan</i>
	Group 6: Tropical thorn forests	Maharashtra, AP, Karnataka, TN, MP, UP, Rajasthan, Gujarat, Punjab	<i>Acacia catechu</i> , <i>A. leucophloea</i> , <i>A. arabica</i> , <i>Capparis deciduas</i> , <i>Prosopis spicigera</i> , <i>Ziziphus mauritiana</i> , <i>Z. nummularia</i>
	Group 7: Tropical dry evergreen forests	Karnataka, AP, TN	<i>Manilkara hexandra</i> , <i>Mimusops elengi</i> , <i>Diospyros ebenum</i> , <i>Memecylone dule</i> , <i>Drypetes sepiaria</i>
Montane subtropical forests	Group 8: Subtropical broad-leaved hill forests	Maharashtra, Karnataka, TN, Kerala, Rajasthan, MP, Odisha, WB, NE India	<i>Eugenia wightiana</i> , <i>Memecylon</i> sp., <i>Quercus vercus</i> , <i>Q. serrata</i> , <i>Castanopsis tribuloides</i> , <i>C. indica</i> , <i>Alnus nepalensis</i>
	Group 9: Subtropical pine forest	Western and central Himalaya, Punjab, Uttarakhand (UK), Sikkim, Meghalaya, Manipur	<i>Pinus roxburghii</i> , <i>P. insularis</i> , <i>Quercus griffithii</i> , <i>Rhododendron arboreum</i> , <i>Syzygium cumini</i>

(continued)

**Table 23.1** (continued)

Major forest groups	Forest type groups	Distribution	Dominant species
	Group 10: Subtropical dry evergreen forests	Shivalik hills, Western Himalaya, Jammu, and Punjab	<i>Olea cuspidata</i> , <i>Acacia modesta</i> , <i>Punica granatum</i> , <i>Dodonaea viscosa</i>
Montane temperate forests	Group 11: Montane wet temperate forests	TN, Kerala, eastern Himalaya, WB, Assam, NE India	<i>Ternstroemia gymnanthera</i> , <i>Eugenia calophyllifolia</i> , <i>Meliosma wightii</i> , <i>Rhododendron nilagiricum</i> , <i>Quercus lamellosa</i> , <i>Q. pachyphylla</i> , <i>Machilus edulis</i>
	Group 12: Himalayan moist temperate forests	Jammu and Kashmir (J&K), Punjab, Himachal Pradesh (HP), UK, WB, Assam, eastern Himalaya	<i>Abies densa</i> , <i>Cedrus</i> spp., <i>Picea spinulosa</i> , <i>Pinus wallichiana</i> , <i>Tsuga dumosa</i> , <i>Quercus dilata</i> , <i>Q. lamellosa</i>
	Group 13: Himalayan dry temperate forests	J&K, Punjab, HP, UK, Sikkim, NE India	<i>Cedrus deodara</i> , <i>Pinus gerardiana</i> , <i>Juniperus wallichiana</i> , <i>Abies spectabilis</i> , <i>Quercus ilex</i> , <i>Acer pentapomicum</i>
Subalpine forests	Group 14: Subalpine forests	J&K, Punjab, HP, UK, WB, NE India	<i>Abies spectabilis</i> , <i>Pinus wallichiana</i> , <i>Betula utilis</i> , <i>Rhododendron campanulatum</i> , <i>Quercus semecarpifolia</i>
Alpine forests	Group 15: Moist-alpine scrub	Kashmir, UK, Sikkim, Manipur, Western and eastern Himalayas	<i>Rhododendron campanulatum</i> , <i>R. wightii</i> , <i>R. molle</i> , <i>R. thomsoni</i> , <i>Betula utilis</i> , <i>Sorbus foliolosa</i>
	Group 16: Dry-alpine scrub	HP, Kashmir, UK	<i>Eurotia ceratoides</i> , <i>Juniperus wallichiana</i> , <i>J. communis</i> , <i>Artemisia maritima</i> , <i>A. sacrorum</i> , <i>Lonicera</i> spp., <i>Potentilla</i> spp.

(Islam et al. 2015). Forests provide the subsistence needs of ~300 million tribal and forest-dwelling rural poor in India, including trade commodities that produce monetary revenue (Angelsen et al. 2014). More than 50% of the rural tribal population residing in our country (GoI, TRIFED 2019) is dependent on forest and forest resources for their sustainable livelihood (Haque 2020). The living standard of rural people in India mainly depends on the resilience of forests and with the agricultural intensification, the forest productivity is decreasing, which affects their sustenance (Quli et al. 2017). In India's forest-dwelling rural households,

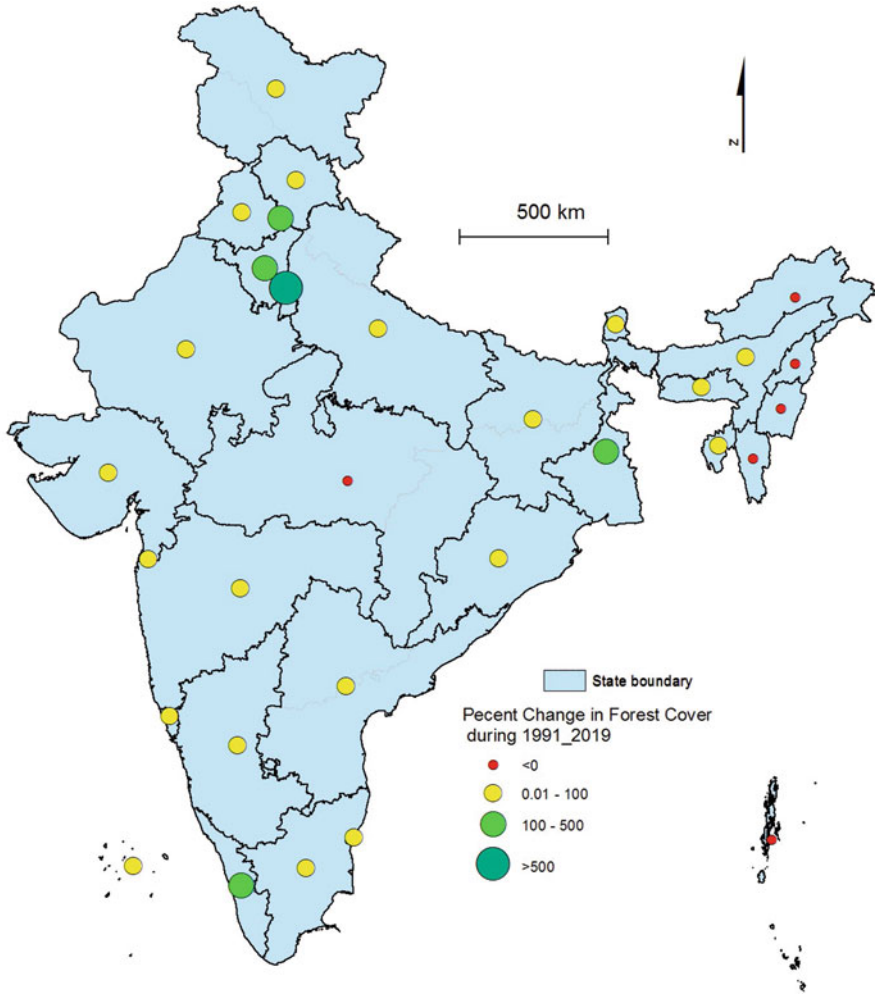
forest-related subsistence and monetary income frequently account for a larger overall income (Angelsen et al. 2014; Belcher et al. 2015). Approximately 40–60% of the total annual earnings of tribal people are basically based on the collection and selling of forest goods and forest-based products (GoI TRIFED 2019). Realizing the importance of forest and forest resources, this chapter attempted to provide an overview of the Indian forest and its sustainable uses for the livelihood security of the forest-dwelling rural Indian populations.

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## 23.2 Indian Forests and Forest Cover Change

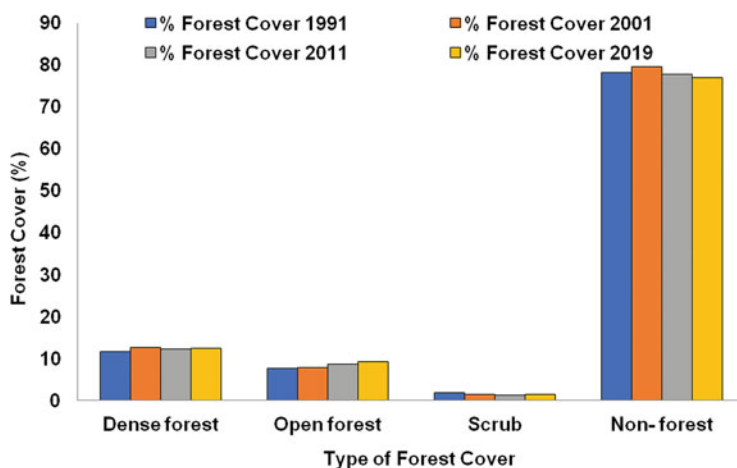
Despite possessing only 2.5% of the world's total geographical area and 1.8% of the world's total forest area, India is home to 16% of the world's people (Maan and Chaudhry 2019). India's overall forest cover is 7,12,249 sq. km (of which mangrove contributes 4975 sq. km), accounting for 21.67% of the country's entire geographical area (FSI 2019), but unfortunately, the overdependence and unsustainable harvesting of the forest resources by large forest-dependent populations have degraded 1.6 M ha of forest cover (INAB 2019). A comparative assessment of forest cover change from 1991 to 2019 in the states and UT of India as per SFR (FSI 1991, 2019) showed a drastic change in forest cover (Fig. 23.1) with an increase of 73,067 sq. km, that is, 2.23% of the total forest cover. The dense forest cover of India has increased by 0.68%, while the open forest cover has been enhanced by 1.63%, and scrubland has decreased by 0.41% during the last three decades (1991–2019) (Fig. 23.2).

Dense and open forests are increasing at a steady rate in all three decades (1991–2001, 2001–2011, and 2011–2019). Simultaneously, the nonforest cover is constantly declining from 2001 (79.45%) to 2011 (77.67%) and 2019 (76.92%). Forest cover change is reaching near 1800 sq. km, which is more than 20% in some states and UTs like Delhi, Goa & Daman Diu, Chandigarh, West Bengal, and Kerala have marked increased forest areas by more than 5%, whereas forest-rich UTs and states like Andaman & Nicobar island (10.68%), Nagaland (10.81%), Mizoram (4.06%), and Manipur (4.64%) have decreased forest areas as compared to 1991. Forest-rich north Indian states have seen tremendous deforestation in the past 30 years with ~14,000 sq. km of forests destroyed to accommodate various economic and industrial projects (Roy 2020). On the other hand, various forest-poor states and union territories such as Delhi, Haryana, Kerala, and West Bengal showed an increase in forest cover (FSI 2019), of which Delhi showed the highest percent change in forest cover during the period 1991 to 2019 due to successful implementation of several afforestation and reforestation programs such as urban forestry, social forestry, farm forestry, extension forestry, etc., and other forests and sustainable development programs (FSI 2019). Better conservation measures, protection, afforestation efforts, tree plantation drives, and agroforestry may be responsible for the increase in forest cover or improvement in forest canopy density (Roy 2020). The 2019 joint progress report on forest restoration by the International Union for Conservation of Nature (IUCN) and the Ministry of Environment, Forest and



**Fig. 23.1** Forest covers change during 1991–2019 (FSI 1991, 2019)

Climate Change (MoEFCC) shows that, despite some percent of land loss over the last few decades, some 9.8 M ha hectares of deforested and degraded land have been restored since 2011 (IUCN 2021).



**Fig. 23.2** Change in forest cover in different forest types during 1991–2019

### 23.3 Climate Change Impacts on Forests and Its Role in Climate Change Mitigation

Climate change is widely acknowledged as a major man-made global environmental threat with significant contemporary impacts on biodiversity patterns (Sahney et al. 2010) and will continue to be a primary driver of biodiversity change in coming years as well (Sala et al. 2000). Climate change has a direct effect on decreasing biodiversity (Loarie et al. 2008) by reducing the species variability and a higher rate of species extinction (Franco et al. 2006), affecting biological systems' ability to serve human requirements (Dar et al. 2020). Industrialization, urbanization (Dar et al. 2020), and intensified agricultural activities are considered as the main factors for shifting the land use and land cover pattern (Ahmad et al. 2018) by increasing constraints on habitat, landscapes, and biodiversity (Stanners and Bordeaux 1995). Forest fire is also a phenomenon that is enhanced by the changing climate and ultimately ends in desertification (Abrams et al. 2018). Plants respond to climate change in four ways: phenotypic plasticity, which allows species to survive in changing climates, evolutionary adaptation to new climates, emigration to better habitats, and extinction (Bawa and Dayanandan 1998; Saxena and Purohit 1993). Climate change influences life cycle events of plants along with their distribution pattern in altitudinal, latitudinal, and longitudinal gradients (Lynch and Lande 1993; Parmesan and Yohe 2003). Phenology is being used to determine the sensitivity of a species to changing climate (Bharali and Khan 2012). Climate change is also responsible for reducing genetic diversity by changing genetic drift, migration of species, and directional selection of species (Rinawati et al. 2013). Different species of plants are moving their habitat ranges in elevation and latitude in response to

changing scenarios of climatic circumstances (Saikia et al. 2016). Poleward shifting of species with respect to climate change again enhances the diversity of invasive plant species and simultaneously reduces the native plant diversity (Katz and Ibáñez 2016).

Forests are the world's most prominent terrestrial ecosystems, serving as a shelter for a variety of terrestrial biodiversity (Hui et al. 2017; Pan et al. 2013). Highly biodiverse forests can reduce the rate of global climate change and boost resilience, because they are rich in species (Bruno et al. 2003). Forests are appealing in terms of mitigating global climate change as they are considered the most productive among the terrestrial ecosystems and have a woody composition that lasts a long time (Nabuurs et al. 2007). Forests also provide a variety of important ecosystem services that help to mitigate the consequences of climate change by limiting water and wind erosion, shading lower-story vegetation, and conserving soil moisture through litter accumulation (Espeland and Kettenring 2018). Tropical forests and savannas account for ~60% of worldwide terrestrial photosynthesis each year (Field et al. 1998). Carbon is divided fairly evenly between plant and soil in tropical forests, 84% of carbon is present in soil organic matter, and only 16% in active living biomass in high latitude forests, particularly in the boreal zone (Malhi et al. 1999). Forests help in balancing both ecological and economical aspects with reference to changing climate (Dar et al. 2020). Besides, forests have altered the gaseous makeup of the atmosphere, which has influenced global temperatures and weather patterns (Sigman and Boyle 2000; Zachos et al. 2001). By trapping particulate matter on the leaf surface, forests can help to reduce pollution levels (Chiabai et al. 2018). Terrestrial ecosystems, mainly forests, also manage to reduce CO<sub>2</sub> up to 1/3rd level released due to anthropogenic activities to the environment (Grassi et al. 2017). Plants have also been shown to lower the speed and severity of cyclones and storms, both of which can result in flash floods (Hu et al. 2015).

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### **23.4 Impact of Forest Products on Livelihood and Their Sustainable Uses**

Approximately 33% of forest cover of the earth's surface area (FAO 2015) serve a critical role in preserving the species diversity along with key ecological products and services in order to keep human life viable (Daily 1997). It performs a variety of regulatory functions, including maintaining air, water, and soil quality, controlling climate, floods, pollination, and biological control of diseases and pests (Bahuguna and Bisht 2013). A major portion of India's tribal population relies on forests for survival, as marketable goods provide financial income when markets are available at a favorable distance and also forest goods act as raw materials for a range of processed industrial products (Angelsen et al. 2014). Forest products can meet a variety of human needs, including material needs like wood, paper, ecological needs like soil erosion check, mitigating climate change, and socioeconomic needs like providing employment to the community, business opportunities, wealth creation, recreational needs, and sources for both individual and family (Richardson 2006). In



wood-based and small-scale forest-based enterprises, the use of local skills and village-level technology provides secondary employment and livelihood prospects for people (Islam and Quli 2016). Forest products are valuable cultural and spiritual resources in addition to being providers of food, medicine, and finance (Rist et al. 2012). Besides, people living in and around forests rely on NTFPs for their survival with limited nonagricultural earning options (Quang and Tran 2006) as it contributes significantly to the rural livelihoods of India's forest-dependent inhabitants (Chandrasekharan 1994; FAO 1991).

Around 80% of the population in developing countries relies on NTFPs for their nutritional and medicinal requirements (Brack 2018). Almost 70% of NTFPs are collected in the tribal belt in India (Pandey et al. 2016). NTFPs-based small-scale enterprises contribute up to 50% of revenue, 55% of employment in the forestry sector, and 20–30% of rural inhabitants are dependent on NTFPs collection, harvesting, processing, and marketing (Joshi 2003). The collection of tendu leaves employs over 7.5 million people in India for roughly 90 days each year (Mistry 1992). The promotion of NTFPs for community development, poverty reduction, livelihood security, and socioeconomic development of forest-dependent communities is driven by sustainable collection, usage, and commercialization (Shit and Pati 2012).

NTFPs are typically the key motivators for local forest management participation (Ahenkan and Boon 2010). Systematic collection of NTFPs may boost the economic prospects of forest dwellers, while also reducing their overreliance on timbers, which may be an effective way to address the problem of forest degradation (Ghoshal 2011). The quantity of NTFPs obtained by the forest dwellers varies greatly according to season, access, and alternatives (Warner 2000). Forest products provide 20–25% of personal wages to forest dwellers in developing nations (Vedeld et al. 2007) and simultaneously provide safeguards during times of crisis and food shortages (Shackleton and Shackleton 2006). NTFPs are a major source of livelihood based on forest restoration in sustainable forest management as NTFPs serve as a means to alleviate the need for environmental conservation and the financial, social, and livelihood needs of communities (Delgado et al. 2016).

One facet of sustainable forest management is the involvement of the forestry sector in national economies (FAO 2021). More than 25% of the livelihood security of the global population depends on valuable and renewable natural resources (Kaur and Mittal 2020). Increased timber commerce has aided economic growth and poverty reduction in various developing countries (Anonymous 2016). Harvesting timber and fuelwood boosts the rural economy by contributing significantly to increased self-sufficiency, family income, and job opportunities (Hall et al. 2015). Timber collection and sale are the primary sources of revenue for the forest-dwelling population in the majority of developing nations (Belcher et al. 2015; Htun et al. 2017).

Wild edible plants are a rich source of medications that can be used to cure a variety of ailments (Bako et al. 2005) and also to supplement the nutritional requirements of rural tribal populations (Kumar and Saikia 2020). In rural areas, herbal medicines play an important role, and numerous locally made drugs are still

utilized as household cures for a variety of disorders (Qureshi and Ghufran 2005). Local healers or indigenous groups have vast expertise and information about each species, as well as a deeper understanding of medicinal flora, formulations, and therapeutic powers that can be utilized to cure a variety of disorders (Saikia and Khan 2011). For poor rural people, the utilization of medicinal herbs and aromatic plants as additional food and ethnomedicine, as well as the potential financial gain, is an enormously essential source of livelihoods and resilience (Shrestha et al. 2020). Medicinal plants are found in India's Himalayas, sea, desert, and rainforest ecosystems, and plant compositions are used in ~95% of traditional systems such as Unani, Ayurveda, Homeopathy, and Siddha (Satyavati et al. 1987). People in developing nations such as Bangladesh (90%), Myanmar (85%), India (80%), Nepal (75%), Sri Lanka (65%), and Indonesia (60%) have a strong belief in traditional herbal therapies as it has few side effects and is very cheap (Salam et al. 2016).

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### 23.5 Policy Interventions for Sustainable Forest Management

Policies play a critical role in preserving forests and meeting people's needs (Pratap 2010; Saxena 1999), while forest policies basically deal with wood production and conceptually on the subject of sustainable yield (Shah 2020). Systematic forest management and forestry policies have been undertaken since 1855 by the British colonialists with the Charter of Indian Forests (Roy 2020). The National Forest Policy of 1952 formally acknowledged the protective effect of forests and established a national aim of 33% forest cover that plays a major role in maintaining the ecological balance and simultaneously meeting the demand of stakeholders by the initiation of the first policy in India through production forestry (GoI, National Forest Policy 1952). The National Forest Policy of 1988 resulted in a shift in perspective from revenue-driven forest management to conservation-driven forest management (Joshi et al. 2011). The National Forest Policy (1988) (GoI, National Forest Policy 1988) established the collaborative management strategy among village communities, nongovernmental organizations, and state forest departments bolstering ecological security, sustainable forest management, and participatory forest management, with the purpose of maintaining ecological balance and environmental stability, particularly atmospheric equilibrium, for the survival of all life forms (Rawat et al. 2008).

Indian Forest Act, 1927, covers all the laws related to forests, regulates forest production, and imposes taxes on timbers and other forest products (Asia Pacific Law and Policy Review 2019; Pratap 2010). The Forest Conservation Act of 1980 and the Wildlife (Protection) Act of 1972 were enacted to prevent further deforestation of India's forest areas by requiring the central government's approval for the diversion of forest land for nonforest purposes. Meanwhile, the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act of 2006 recognizes communities' traditional rights to forest land and tackles difficulties surrounding the transfer of tribally managed forest properties to the state government. Through afforestation, the National Action Plan on Climate Change (NAPCC)

of 2008 aims to cover one-third of India's land area with forest cover. Later, the current National Forest Policy (2018) intends to protect people's ecological and livelihood security, both now and in the future, through sustainable forest management (GoI, National Forest Policy 2018).

Sustainable Management of Forests, Management of Trees outside Forests, New Thrust Areas in Forest & Tree Cover Management, Strengthen Wildlife Management, Facilitate Forest Industry Interface, Research and Education, Extension and Awareness, Management of North-Eastern Forests are some of the strategies undertaken for sustainable forest management as per National Forest Policy (2018). Legal and institutional frameworks, training and skill development, financial assistance, alignment with other policies and regulations, assimilation of international commitments, promotion of regional cooperation, good governance, a framework for implementing a plan for the future, and periodic review. Besides, India is a signatory to the World Heritage Convention, the Convention on Migratory Species or Bonn Convention, the Ramsar Convention, and five major international conventions on wildlife conservation, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the International Union for Conservation of Nature and Natural Resources, the International Whaling Commission, and the Convention on Biological Diversity (TERI 2015). Some of the strategies for sustainable management of forests (UNFF 2007) are adoption of various community participation measures to reduce the threats to forests, improving the quality and productivity of natural forests by implementing strong conservation measures and planting indigenous species to aid natural regeneration, plantation in degraded and underutilized land with scientific interventions and intensive management, sustainable management of the various NTFPs to provide enhanced employment and economic opportunity for indigenous communities, extensively examined and catalogued country's forest biodiversity, promotion of modern ex situ conservation strategies for the preservation of Rare, Endangered, and Threatened (RET) species.

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## 23.6 Future Research Prospects and Recommendations

A community-based monitoring system needs to be urgently introduced in India for assessing the current status of NTFPs and ongoing changes to safeguard the integrity of natural forests and the sustainable livelihood of the poor forest dwellers. Government investment and/or public-private partnership in the NTFPs production, cultivation, value addition, and manufacturing is necessary to ensure assured return to the producers. With necessary initial technical and financial support, the local people can effectively cope with open market competition. To address the ever-increasing subsistence demands of the human population living on the outskirts of the forest and their rising standard of living, intensive land-use practices including the growing of high-value medicinal plants, agroforestry, and other types of mixed cropping combined with value addition is the need of time to supplement natural forest economy. Finally, the role of forests needs to be seen in a larger perspective of

sustainable development of local communities encompassing education, healthcare, infrastructure, minimum needs, including the entire spectrum of human development. The different government departments need to converge in their efforts under a single delivery system to alleviate poverty in the forest fringe areas.

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## 23.7 Conclusions

The need for forests and their services as well as benefits increases with rising human and livestock populations. The socioeconomic conditions of India will be able to improve by making better use of the natural resources, local awareness, and knowledge as well as skills in different sectors. NTFPs play an important part in stabilizing the rural economy and sustainable livelihoods of India's indigenous peoples; hence, employment in NTFP-based value-added enterprises, as well as their well-organized system of marketing, should be encouraged. Plant-derived medications play a major role in traditional and modernized medical systems, because India is quite enriched in plant diversity. For long-term sustainability, more broad and rigorous research is required to recommend a strategy based on the conservation and preservation of all the medicinal plants and other forest and forest-based products. Forests are a source of income for society by providing direct and indirect uses of numerous ecosystem goods and services that enable people to thrive and live better lives through employment and other opportunities. Forest resources can be sold to create additional sources of income for those living on the outskirts of forests. Agroforestry, urban greenery, plantation programs, and other forest-related management policies and plans put forward multiple strategies for the improvement of forests as well as livelihood.

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