Building Block for

Forest Management

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NAMAMI GANGE

INDIAN INSTITUTE OF PUBLIC ADMINISTRATION
कर्मसु कौशलम्

Handbook for Urban Local Bodies Officers

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Connecting with nature means connect with ourselves. If we do so we nurture a better planet.

- Shri Narendra Modi

FOREWORD

The 74th Constitutional Amendment marks a landmark moment in India's realm of urban local self-governance, creating urban local bodies (ULBs) constitutional entities with the authority to provide better governance and more effective delivery of civic services to communities. It is therefore important for the states to devolve greater responsibility, power, and resources to the ULBs through the devolution of nances and of cials envisioned in the Twelfth Schedule to the Constitution.

Amidst unparalleled economic growth and a rapidly increasing population, India is faced with a series of dif cult decisions regarding its future. With a 7.4 percent average annual growth rate during the previous decade, the country will become the world's fourth largest economy in approximately two decades. Indian Institute of Public Administration, New Delhi holds the cause of *Namami Gange* programme in high priority. We have developed a complete training programme under the project "Blended Capacity Building Programme for Stakeholders of River Ganga" The handbook have been developed in a clear and easy-to-understand manner for the Urban Local Bodies. Though mostly based on missions of *Namami Gange* and state governing municipal administration, it lends itself to customization to meet the special needs of other states and river bodies.

This handbook on Forest Management introduces perspectives of urban local body officers towards trends and challenges, policies, and a framework of sustainable Forest Management in the river Ganga basin state for long-term services sustenance and food security. Further to bring a change in the management tools and practices for sustainable and economic ef ciency in existing forestry practices.

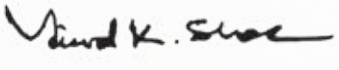
S.N. Tripathi IAS (R)
Director General, IIPA

PREFACE

Since times immemorial, forests have been an integral part of human ecosystem and its environment. Besides providing shelter and protection to a large number of living beings ,including pre-historic man, they have been a major source of food and a great variety of other products. they also played very important role to clean and maintain water bodies. Globally, forests face growing threats, challenges and risks from the natural and anthropogenic disasters, which continue to strike unabated without notice and are perceived to be on the increase in their magnitude, complexity, frequency and the economic impact.

This handbook is intended to facilitate these efforts by outlining a model educational approach, designed to co-create and adopt evidence-based on-Forestry interventions and management that support the livestock which are providing ecosystem services. It is intended to be used byUrban Local Bodies, researchers, and farm educators, including government of cers.

The National Mission for Clean Ganga has made tremendous progress by launching a number of programs and regulatory frameworks to assist state governments with integrated management. Indian Institute of Public Administration, New Delhi has designed modules as a strategic step towards enhancing the ability of urban managers in cities. We are pleased to observe that the progress made in this direction has been chronicled as a step-by-step guide structure in these volumes. Team IIPA is con dent that the module toolkit will motivate communities to reimagine their urban areas as part of the city's integrated vision and urban planning process. We look forward to collaborating with state governments and concerned citizens to protect these natural resources.



Prof. Vinod K. Sharma **Dr. Shyamli Singh**
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Target Audience

- District collectors, Magistrates, Sub-National officials, Development Departments, and Public Services who address development and planning activities
- Officials of Urban Local Bodies, Panchayati Raj Institutions, and Smart Cities Officials who implement the program
- Academia, universities, research institutions that can help documentation and assess the related scenario
- Citizen group and civil society as a whole

OBJECTIVES

Maintenance of Environmental stability and restoration of ecological balance, soil and water conservation.

Capacity building of Forest Department and other stakeholders for effective Ganga biodiversity conservation.

Making people aware of the long term implications of river pollution

Mitigation of and adaptation to climate change

Conservation of biodiverse forest

2,525 Km

Long sacred Ganga river is symbol of India's age long culture and civilization

43%

Country's population is supported by the ganga basin making it one of the most populated regions of the world

172

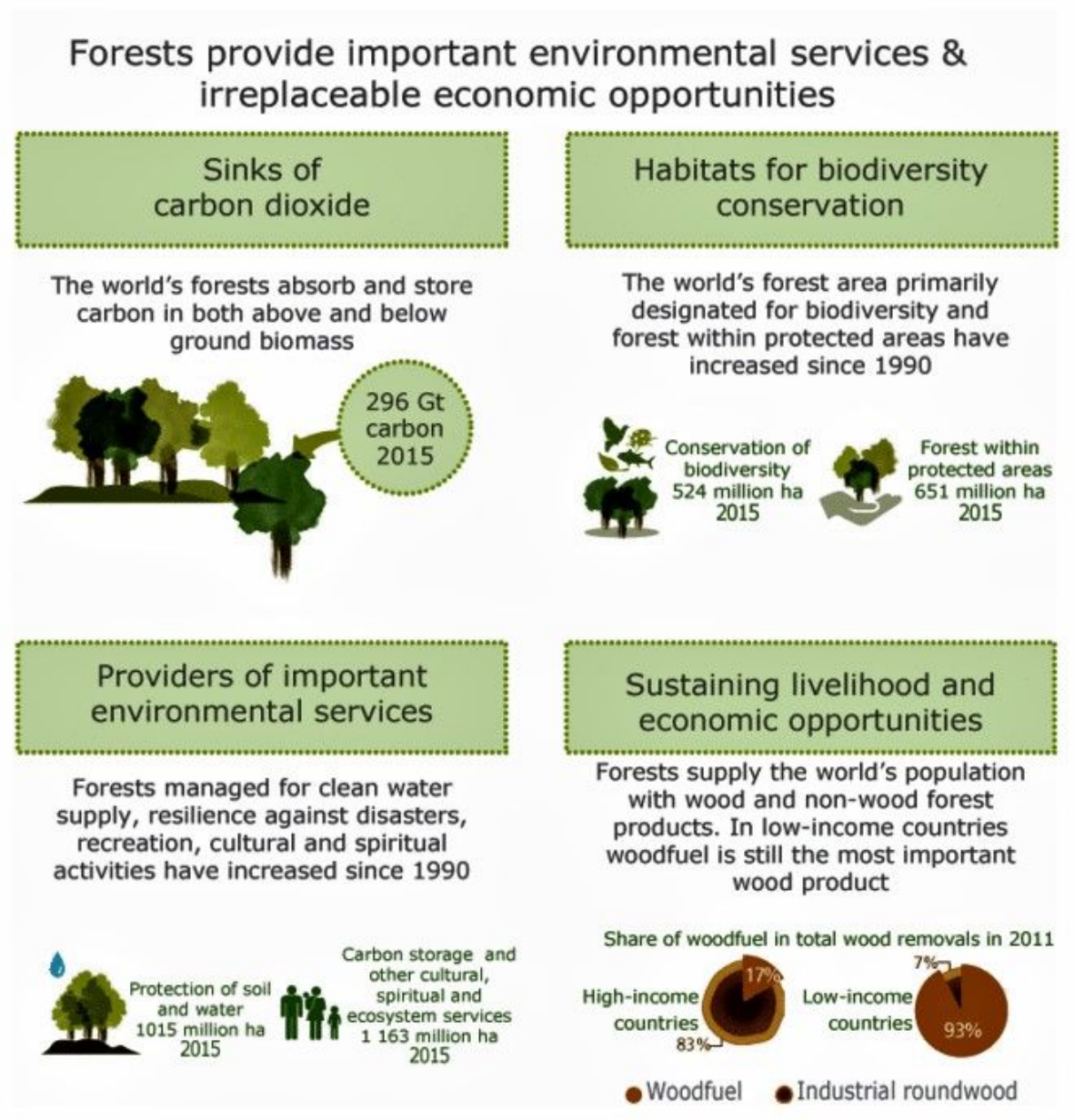
Cities and towns are located on the banks of river Ganga. Being the 'National river possessing immense geographical, environmental and socio-economical signi cance

Why Forest Management?

Forest management is the planning and implementation of practises for the stewardship and use of forests and other wooded land with speci c environmental, economic, social, and cultural goals in mind. Forest management planning is an important part of sustainable forest management at all scales, from local to national scale.

Forest management planning is responsible for determining and expressing forest management objectives in a speci c region of forest, as well as laying out the steps necessary to attain those objectives.

Forest management is important as it provides:



Source: https://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b3-forestry/chapter-b3-1/en/

INTRODUCTION

Forests have always been an important element of human ecosystem. They are nature's greatest gift to humanity and play a vital role in its survival. They have been a major source of food, wood, and a range of other things, in addition to giving shelter and safety to a large number of living beings, including prehistoric man. Forests have bene ted human life in a variety of material and psychological ways since ancient times, playing an essential role in social, economic, and cultural activities.

How to define forests?

Forests have been de ned in various ways, however, an ideal de nition of forest may be:

"Forests constitute the largest, complex & most important natural resource mostly dominated by trees or continuous forest with trees usually growing to more than about seven meters in height & able to produce wood. This includes both closed forest formations where trees of various storey and undergrowth cover a high proportion of the ground and open forest formations with a continuous grass layer in which tree synusia covers at least 10% of the ground. It is also defined as the land with tree crown cover (stand density) of more than 20 percent of its area."

Food and Agriculture Organization (FAO) of United Nations de nes forest in a bit technical sense as “Land with a tree canopy cover of more than 10 percent and area of more than 0.5 hectare”. In this context the forest is de ned not only by the presence of trees but also by the absence of other predominant land uses. However, this de nition of the fores t does not cover its legal aspect. As far as the legal aspect is concerned, it has nothing to do with tree canopy or the tree cover and is simply de ned as an area of land accorded as “Forest” in the revenue records or proclaimed to be forest under “Forest Law or Act”.

In India, while describing forest area, only this legal status of the forest is taken into consideration and according to this “forest area” is an area recorded as forest in the government records and is commonly known as “the recoded forest area”. The recorded forest area can be classi ed as reserved, protected and unclassi ed as de ned below:

1. Reserved Forest (RF): An area noti ed under the provisions of Indian Forest Acts or the State Forest Acts having full degree of protection. In Reserved Forests all activities are prohibited unless permitted.
2. Protected Forest (PF): An area noti ed under the provisions of Indian Forest Act or the State Forest Act.
3. Unclassi ed Forest (UF): An area recorded as forest but not included in reserved or protected forest category. Ownership status of such forests varies from state to state.

Forests are the most signi. cant players in the life of a river and their health, density and composition are vital for maintaining its food web. Hence, in any Ganga restoration plan, the role of trees has to be appreciated and should be an integral component. The river Ganga is one of the most important rivers of the northern India supporting millions of people residing in the river basin. The Ganga river basin, i.e. the area of land that pours all the water flows into Ganga, encompasses not just India but include other nations such as Tibet, Nepal and Bangladesh. However, the Ganga basin in India encompasses 11 States viz., Uttarakhand, Uttar Pradesh, Haryana, Himachal Pradesh, Delhi, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, Chhattisgarh and West Bengal. The river has various tributaries starting from the Himalayan state of Uttarakhand to the Bay of Bengal, where it forms one of the world's largest delta – the Sundarbans. Throughout its course of run, it makes one of the most fertile landscapes with abundance of water and supports world's most populous region. The Ganga basin covers more than a million square kilometers and deposits sediments which are more than a kilometer deep in some places. These are a boon for crops in North India and Bangladesh. Based on historical evidence, until the early 19th century, the bank of the river Ganga teemed with wildlife, including dolphins. The Arthashastra of Kautilya mentions that the banks of the Ganga were covered by forests full of wildlife, including herds of wild elephants.

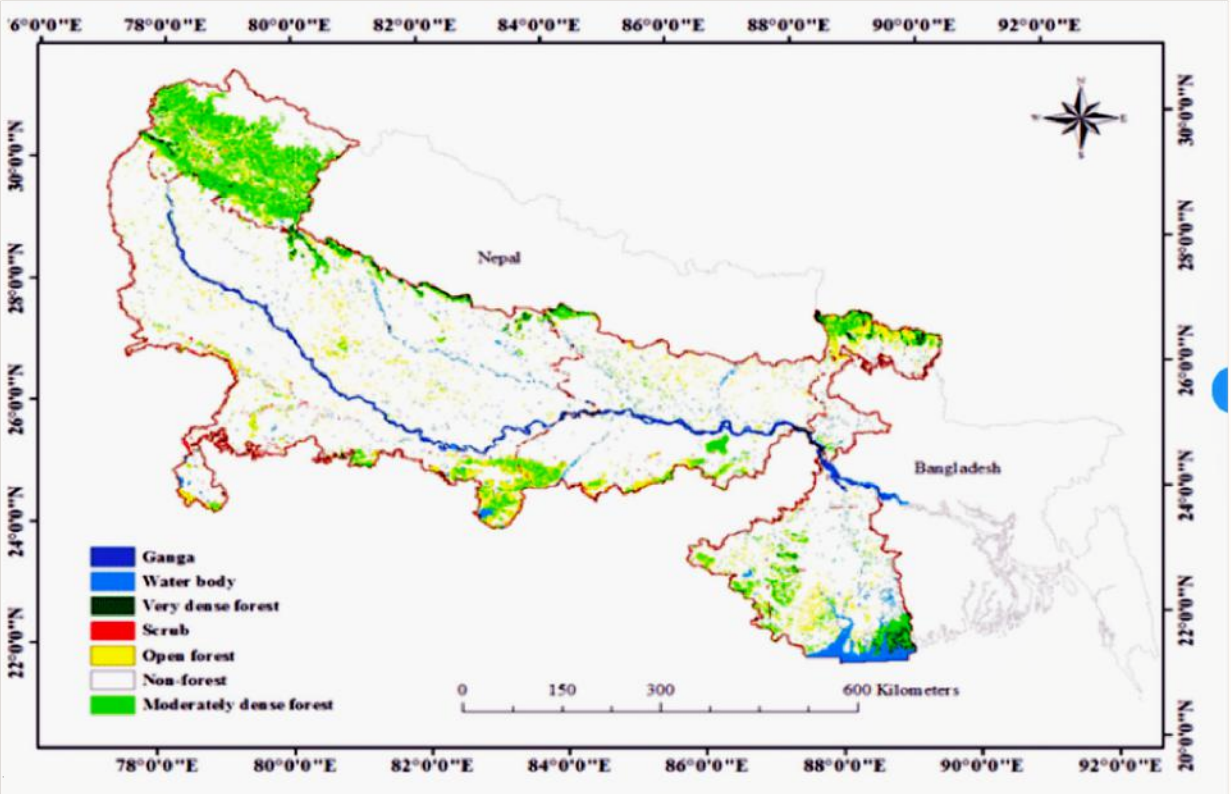


Figure 1: Forest cover density along the stretch of river Ganga in Indian states [derived from FSI (2011a) digital layer]

The Ganga has three distinct zones, the upper catchment, the middle part and the deep lower reaches. All these zones have their own autecology. But in all these parts the surrounding landscapes are key players that influence the river's ecosystem and its integrity. To make the ecological cleansing mechanism effective, the tree cover has to be restored in the catchment and riparian regions. They are the most significant players in the life of a river and their health, density and composition are most important for maintaining the food web of the river. It is the food web of the river that makes it vibrant and living. Hence, in any river restoration plan, the role of trees has to be appreciated and should be an integral component. Out of the 8,51,475 sq km of the Ganga basin, only 5.6 per cent constitutes dense forest, the rest of the landscape comprises open forests, mangroves or shrubs. The function of forests ceases to be effective if density falls below 40 per cent.

The 1995 records of the Forest Survey of India show that 85 per cent of river basins are devoid of any forest cover. While the headwater tributaries of the Ganga, like the Bhagirathi and Alaknanda still support a few stretches of good riparian forest cover, these forests almost disappear downstream. A very high rate of population growth, industrial development and deforestation have qualitatively and quantitatively in. uenced the water adversely. The main concern relates to the deforestation and reduced flow throughout the river system. Some other issues are depletion of biodiversity (flora and fauna) and vegetation cover that are crucial in providing "biological filter" to the river from pollutants and silt. River pollution and siltation has exacerbated in past and continues to be so due to natural as well as anthropogenic factors at the landscape level. The ever increasing population pressure, land use/land cover change in catchment area, construction of large dams, lack of proper investment in water quality infrastructure maintenance, mismanagement at various levels and lack of awareness among people continue to contribute to the deteriorating state of the river. This can be attributed mainly to agriculture, which has been the dominant land use in the Gangetic plains for centuries and has affected the green cover and polluted the river. The relationship between trees and water is quite intricate and requires sound skill, knowledge and field experience to address forest management under varied conditions of terrain, climate, geology and hydrology. Forests filter water from streams that come from agricultural land and recharge the ground water table. Deforestation and conversion of forests to other land uses, charcoal burning and encroachment for settlement undermines the ability of forested landscapes to provide these ecosystem services. Hence, the prevailing situation necessitates a wider participation of different agencies and all stakeholders of river Ganga to improve the quantity and quality of the holy river. At the same time, it also necessitates scientific and technological interventions for the restoration of forests and rejuvenation of the river.

Forest Cover Area, Ganga Basin

Out of the **8,51,475 sq km** of the Ganga basin, only 5.6 per cent constitutes dense forest, the rest of the landscape comprises open forests, mangroves or shrubs. In the states like Haryana, Delhi, Bihar, Uttar Pradesh and Rajasthan, the forest cover is as low as 3.61 to 11.94% of the geographical area. Most of forest tracts within the Ganga basin are severely degraded on account of over exploitation. As a result, the forest ecosystem in the Ganga basin is under severe stress. Even in the states of Uttarakhand (45.8%), Madhya Pradesh (25.21%), Himachal Pradesh (26.35%) and West Bengal (14.64%) where the forest cover is higher, the proportion of the land under dense tree cover is very low due to extensive clear felling of trees carried out in recent decades. The state-wise forest cover in Ganga basin is shown below

Table 1: State-wise forest cover in Ganga basin (Source: Environmental and Social

State	Geographical area (Sq km)	Forest				Geographical area (%)
		Very dense forest (Sq km)	Moderatly dense forest cover (Sq km)	Open forest (Sq km)	Total (Sq km)	
Bihar	94,163	231	3,248	3,325	6,804	7.23
Delhi	1,483	7	50	120	177	11.94
Haryana	44,212	27	463	1,104	1,594	3.61
Himachal Pradesh	55,673	3,224	6,383	5,061	14,668	26.35
Jharkhand	79,714	2,590	9,899	10,405	22,894	28.72
Madhya Pradesh	3,08,245	6,647	35,007	36,046	77,700	25.21
Rajasthan	3,42,239	72	4,450	11,514	16,036	4.69
Uttar Pradesh	2,40,928	1,626	4,563	8,152	14,341	5.95
Uttarakhand	53,483	4,762	14,165	5,568	24,495	45.80
West Bengal	88,752	2,987	4,644	5,363	12,994	14.64
Ganga Basin States	**1,308,892**	**22,173**	**82,872**	**86,658**	**1,91,703**	**14.65**
India	**3,287,263**	**83,510**	**3,19,012**	**2,88,377**	**6,90,899**	**21.02**

Table 2: Extent of forest cover in Ganges basin (Source: Forest Survey of India, 1995)

Catchment area	Dense forest	Open forest	Mangrove	Total	Scrub	Non-Forest	Grand total
Ganga Basin	63,011	47,682	2,119	1,12,812	9,898	7,28,965	8,51,675
% of Basin Area	7.40	5.60	0.25	13.25	1.16	85.60	100.00

Source: http://cganga.org/wp-content/uploads/sites/3/2018/11/032_ENB_RIPARIAN_0.pdf

Habitats in Ganga Basin

The biodiversity of National River Ganga is unique as it synthesizes three very different ecoregions of India situated along climatic gradients, namely the Himalayas, the Gangetic plains and the Deltaic regions. The distribution of ora and fauna being largely dependent on the substrate, habitat and trophic status, the presence or absence of a particular family, genus or species is indicative of the conditions prevailing in the eco-region. The ora of Ganga basin comprises majorly of tropical moist and dry deciduous forest. Further, the faunal resources are divided into three distinct categories namely, Upper Ganga, middle Ganga and lower Ganga. The pollution levels in the middle Ganga are severe and lower Ganga has sedimentation problems from Nepalese tributaries.

Forest Type	Distribution	Major Species
Tropical Dry Deciduous	Sutlej-Ganga Plains, Himalayan Foothills and Eastern plateau	Sal, Teak, Sandal wood, Arjun Jarul, Ebony,Mulberry,Kusum siris, Palas, Mahua, Simul and Dhup
Tropical Moist Deciduous	Eastern Rajasthan, Kathiawar, Punjab, Central India, Rain shadow area of Deccan Plateau	Teak,Sal,Bijasal,Laurel, Palas,Khair and Kendu
Sub-Tropical Coniferous Vegetation	North West Himalaya between 1000-1800 m	Chir-Pine
Himalayan Dry Deciduous	Western Ghats below the range of 1000 m	Chilgoza Deodar, Oak, Maple, Ash, Celtis, Parotia, Olive Oak
Himalayan Moist Vegetation	Western Himalaya elevation between 1500 and 3000 m	Deodar, Spruce, Maple, Walnut,Poplar,Cedar, Chestnut, Birch and Oak

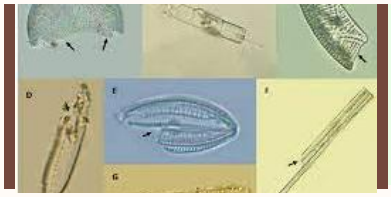
Table 2: Major Vegetation types of Ganga

The Ganga is home to a diverse array of flora and fauna, including the endangered Ganges river dolphin (Platanista gangetica gangetica) and at least nine other aquatic mammal species. Reptiles include three species of crocodiles along with one species of monitor lizard (Varanus bengalensis) and eleven species of freshwater turtles. In addition, the Ganga features India's most diverse freshwater fish fauna (378 species).
The riparian zone hosts various plant species that are of both ecological and economic interest. The majority of plants serve a vital role in nutrient and water conservation, as well as soil erosion control. They also have vital therapeutic benefits in several circumstances.
The Sundarbans mangroves, which encompass an area of 20,400 sq km in a chain of 54 islands where the river meets the Bay of Bengal, are the world's biggest mangrove ecoregion. They derive their name from the major mangrove species, Heritiera fomes, also known as sundari in the area. The endangered Royal Bengal Tiger (Panthera tigris), the Indian Python (Python molurus), and crocodiles all live in the delta (Crocodylus porosus). The Irrawaddy Dolphin (Orcaella brevirostris) and the Ganges River Dolphin (Platanista gangetica) are both found in the delta. The Ganges river dolphin is significant not just because it is endangered, but also because it is a reliable indicator of the health of river Ganga and entire ecosystem. This is why the Indian government declared it as the "National Aquatic Animal" in 2009.

Zone	Species
Sub Tropical Zone	Chir*(Pinus roxburghii)*, Utis *(Alnus nepalensis)*, Kaamala Tree *(Mallotus philippensis)*, Indian mahogany*(Toona ciliate)*
Temperate zone	Oak(*Quercus spp.)*, Deodar *(Cedrus deodara)*, *(Juglans regia)*, Buransh *(Rhododendron arboretum)*, morinda *(Picea smithiana)*
Sub-alpine zone	Brammi *(Taxus wallichiana)*, Oak *(Quercus semecarpifolia)*, Chir*(Pinus wallichiana)*,
Alpine zone	Heathgrass *(Danthonia cachemyriana)*, Spikenard *(Nardostachys jatamansi)*, katuka *(Picrorhiza kurroa)*, Kunth *(Androsace globifera)*, Arand *(Acontium heterophyllum)*, Kashmir balsam *(Acontium balfourii)*, Cushion Rock Jasmine *(Gentiana sp.)* and Five . ngers *(Potentilla sp)*

Table 3: Diversity of Flora

The biodiversity in the Ganga river may be grouped under seven heads :



Phytoplankton (tiny free-floating living organisms that drift with the water and constitute the main autotrophic base of the food chain in the Ganga ecosystem)

Periphytons (which, together with phytoplankton, comprise 1176 Taxa of attached and free-floating algal forms)

Zooplanktons (comprising 294 Taxa of largely macroscopic or assemblage of microscopic free-floating animals)

Zoobenthos (comprising 73 families of insects including higher forms that group under rocks and boulders spending part of their life as larvae and those which live and grow on soft substrate)

Fish (of 284 species plus 13 Chondrichthye species)

Higher aquatic vertebrates (comprising Reptiles, Amphibians and Mammals that include 13 species of hard and soft turtles, besides the Gangetic dolphin, gharial, crocodile and porpoise)

Macrophytes (which are higher forms of plants that grow free floating or submerged in water bodies

Together, these micro- and macro-organisms, through their interplay with the abiotic environment, represent the ecological status of National River Ganga.

Emerging Global Environmental Threats to Forest Water Resources

1 **Climate change: warming temperature, increasing storms, and water level rise**

2 **Population growth, urbanization, land use change, and demographic change**

Climate change refers to the changes of meteorological variables such as air temperature and precipitation over an extended period in terms of their average and/or variability. Elevated concentrations of atmospheric carbon dioxide (CO_2) and other greenhouse gases are the causes of climate change. Climate change is hydrological change, thus it has direct and indirect impacts on forest ecosystems through altering the amount and timing of water and energy movement and availability. One of the most observable changes is hydrologic intensification: the increased frequency of hydrologic extremes such as low and high flows. While changes in annual mean (or totals) values in metrics such as streamflow and groundwater recharge are important, a greater challenge is posed by changes in hydrologic extremes.

Many of the tools (e.g., models), guidelines, and best management practices have been developed based on historical (and soon to be obsolete) hydrologic conditions and disturbance regimes.

A key question is whether existing approaches and tools for protecting and enhancing water resources will be sufficient to mitigate or adapt to future conditions

Population growth is a strong driver of urbanization, land use change, and water supply stress. By 2050, the world population is projected to be 9.6 billion and majority of the total population is expected to live in urban areas. Population expansion over the next century is expected to occur primarily in less- developed regions placing more pressure on forest ecosystems to provide essential ecosystem services. Urban expansion is usually characterized as increasing impervious surface areas and losing agricultural and forest lands bring many well-recognized environmental consequences such as water shortages and air and water pollution.

While the process of urbanization has important implications for changes in demographic characteristics and transformation of the physical landscape, unplanned, unsystematic and rapid urbanization can cause profound impacts on various environmental components, especially on land and water. In particular, urbanization affects watershed microclimate, surface water dynamic groundwater recharge, stream geomorphology, biogeochemistry, and stream ecology. Forested watersheds are often the most important sources of clean water for city inhabitants.
We lack knowledge of the impacts of urbanization on ecosystem structure and function, society, and culture under future climate change and how forest management can play a role in an urbanizing world to reduce the negative aspects of urbanization.

Over Population

- **Home of more than 500 people**
- **Most populated river basin in the world**
- **population density of about 600 per square km**

Urbanization

29 Class I cities
23 class II cities
50 towns
Big urban agglomerations

- Delhi (16349831)
- Kolkata (14,035,959)
- Kanpur (2,920,496)
- Lucknow (2,902,920)

Deforestation

- **80% of the original forest has been lost**
- **Ganga plain is among the least forested regions of India**
- **Causes flooding, water pollution, habitat degradation and biodiversity loss**

Intensive Agriculture

- **Intensive use of natural resources, and agrochemicals**
- **Annually, more than 0.1 million tons of fertilizers enter in the Ganga**
- **Most often used forest farming on forest land for income.**

Challenges to Forest Water Management

A **Rapid and Complex Environmental Changes**

B **Deforestation and Forest Degradation**

C **Challenges to Existing Best Management Practices (BMPs) and Modeling Tools**

Over the past few decades, environmental changes have accelerated and are expected to accelerate even more rapidly in the future. Changes in the earth's climate have significant impacts on forest water resources by altering the ecohydrological processes such as plant growth rate and water use efficiency and consequently water balances.

Direct effects include the influences of altered precipitation amount, timing, and variation, and changes in temperature and elevated atmospheric CO^2 concentration. on other hand indirect effects include vegetation responses to these direct changes and other disturbances and stressors, such as fire, insect outbreaks, tree mortality and sea level rise that are indirectly altered by direct effects. These changes are complex and often occur in combination. An even greater challenge will be new combinations and interactions that we have not observed. Changing conditions may favor (or tolerate) new invasive species that may increase wildfire risk and/or permanently alter hydrologic processes. For example, wetter conditions, fire suppression, and the maturation of much of the forest following widespread harvests in ganga basin have resulting in forest "mesophication", a process of shifting species dominance to more xeric conditions. Mesophication caused an increase in evapotranspiration and an decrease in water yield.

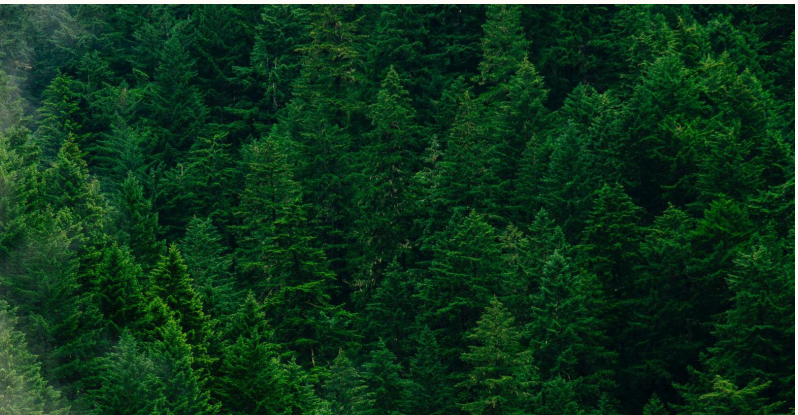
It is difficult to predict how forest ecosystems will respond to traditional forest management practices in a novel environment. For example, fertilization under drought may do harm to plantation forests and increase vulnerability to drought. At the large watershed scale, climate change impacts may be masked by management effects. For example, deforestation (deforestation) generally increases (decreases) streamflow, but the influences of this management practice could be offset by increasing or decreasing precipitation and greater evapotranspiration due to climate warming.

Deforestation is conversion of any forest to other uses e.g. croplands, pastures, or urban land. Degradation refers to reduction in productivity and/or diversity of a forest due to unsustainable harvesting (removals exceeding replacements, changes in species composition), re (except for re dependent forest systems), pests, diseases, removal of nutrients and pollution/climate change (changes in productivity, total organic matter, and forest composition). Forest degradation occurs when forest ecosystems lose their capacity to provide important goods and services to people and nature. Widespread forest degradation in developing countries remains poorly understood and quanti ed. Over half of the tropical forests worldwide have been destroyed since the 1960s, and every second, more than one hectare of tropical forests is destroyed or drastically degraded. Over half of the tropical forests worldwide have been destroyed since the 1960s, and every second, more than one hectare of tropical forests is destroyed or drastically degraded. This intense and devastating pressure on forests is not limited to the tropics – an estimated 3.7 million hectares of Europe's forests are damaged by livestock, insects, diseases, forest res, and other human-linked activities.

Source: https://www.iucn.org/resources/issues-briefs/deforestation-and-forest-degradation

Simulation models have been widely used in forest ecohydrological research and watershed management. However, the ability to predict the impacts of extreme events presents considerable challenges to existing models. Performance of watershed-scale models, lumped models in particular, is often evaluated on data that have been averaged in space and time and this precludes evaluation of performance of extreme events such as drought and flooding events. Where finer resolution evaluations have been conducted, model performance of most hydrologic models is often poor, especially for drought conditions. The impacts of high rainfall events on streamflow are easier to model because once soils are saturated, hydrologic responses are driven primarily by physical features of the watershed. If these characteristics are well defined, then flood characteristics (amount, timing, location, etc.) can be predicted with relative certainty. However, in mountainous terrain, large storms may increase landslide risk and understanding and modeling the biophysical controls on landslide risk in space and time are difficult.

Extreme climates, such as drought, . oods or change in water level are often environmental stressors but their impacts are observable at a range of spatial scales (i.e, tree, stand, basin). Forest best management practices must be designed site specific to suit local watershed physical conditions such as topography, geology and soils, drainage patterns, but they also should consider future climate and hydrologic conditions. Many of the existing models are not capable of providing the data required to assist water managers. F or example, hydrologists require weekly information on streamflow quantity and quality at a spatial scale specific to the water intake or storage reservoir for the watertreatment facility. However, models are typically generic and require specific parameters for each watershed with its own set of features and management systems. Watershed management teams must also understand how changing terrain conditions, forest types, and climate interact to identify risks and vulnerabilities, as well as assess management options for mitigating them. As a result, models and tools must be dynamic and account for changing land uses, species and structure, as well as disruptions at fine spatial (e.g., tree) and temporal scales (e.g., storm event). To overcome these challenges by providing policy advice, technical support and capacity building through field projects, workshops, and hands-on training.



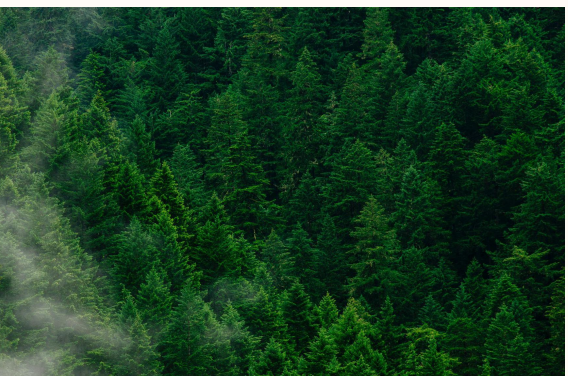
Sustainable Forest Management

Sustainable forest management (SFM) is de ned as a "dynamic and developing concept that aspires to sustain and increase the economic, social, and environmental qualities of all types of forests for the bene t of current and future generations." When forests and trees are managed sustainably, they bene t people and the environment by boosting livelihoods, providing clean air and water, protecting biodiversity, and adapting to climate change.
Sustainable forest management entails maximizing the bene ts of forests, such as timber and contributions to food security, while conserving and maintaining forest ecosystems for the bene t of current and future generations. Although signi cant progress toward SFM on a global scale, its implementation is widely diversi ed, particularly in the tropics, where capacity to use or enforce SFM policies, laws, and regulations is inconsistent. Furthermore, other land uses such as agriculture are often nancially more attractive in the short term compared to forest management, motivating deforestation and land-use changes.

It recognizes seven thematic elements of sustainable forest management:

- Extent of forest resources;
- Forest biodiversity;
- Forest health and vitality;
- Productive functions of forest resources;
- Protective functions of forest resources;
- Socio-economic functions of forests; and
- Legal, policy and institutional framework.

Using sustainable forest management as an overall framework helps ensure that adaptation and mitigation measures are carried out in synergy with other forest management objectives and take into account the economic, social and environmental value of forests.



Approaches Supporting SFM

1. Adaptive management

It is a dynamic approach to forest management in which changing conditions are monitored and practices modified accordingly. It explicitly addresses complex and uncertain situations and is widely seen as part of an appropriate overall response to climate change, including in the forest sector.

2. Partnerships and participatory approaches

It can operate at a range of levels, from the national to local level. They may involve state and local authorities, forest extension agencies, forest-dependent communities, non-governmental organizations, private-sector entities, research and academic organizations, and forest managers.

3. Landscape approach

A framework to integrate policy and practice for multiple land uses, within a given area, to ensure equitable and sustainable use of land while strengthening measures to mitigate and adapt to climate change. It also aims to balance competing demands on land through the implementation of adaptive and integrated management systems.

4. Indigenous Knowledge

Forests and associated ecosystems have been maintained by local and indigenous groups for generations. They have done it in ways that have allowed them to maintain their livelihoods and cultures without harming ecosystem's ability to deliver a continuous supply of products and services. The knowledge, innovations and practices of these communities have evolved through experiences gained from their encounters with changes in environmental, economic, political and social conditions.

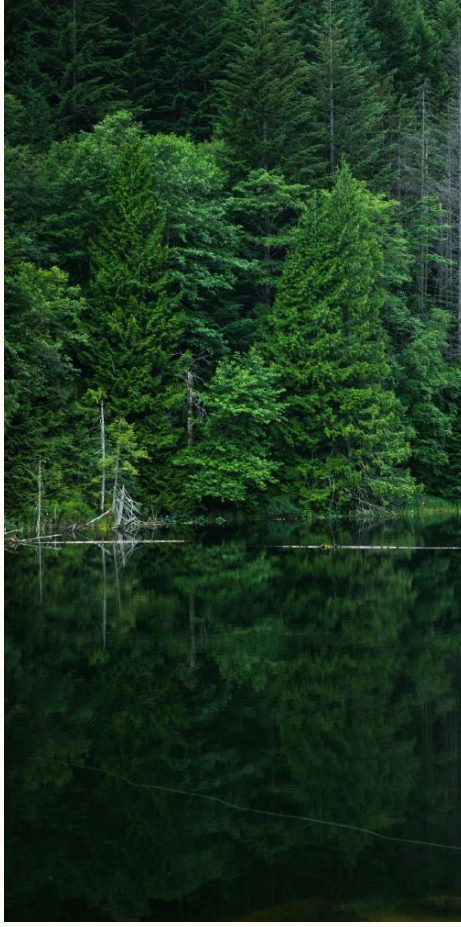
Traditional knowledge is typically passed down orally from generation to generation through stories, songs, folklore, and proverbs, as well as elders' direct training of youth. Traditional knowledge, which is supported by and embodied in local languages, cultural values, beliefs, rituals, laws, and governance systems, has resulted in a diversified range of natural resource management techniques that ensure food security, health, and traditions. Natural forest management, shifting cultivation, and agroforestry systems are examples of complex forest management practices based on traditional knowledge that continue to meet the material and non-material needs of societies without adversely affecting the biodiversity and functional integrity of forests and associated ecosystems.

Principles of SFM

1 Nature Protection Principle

Ecologically sustainable forestry responds to environmental concerns caused by deforestation. In particular, environmentally sustainable forest management ensures the following:

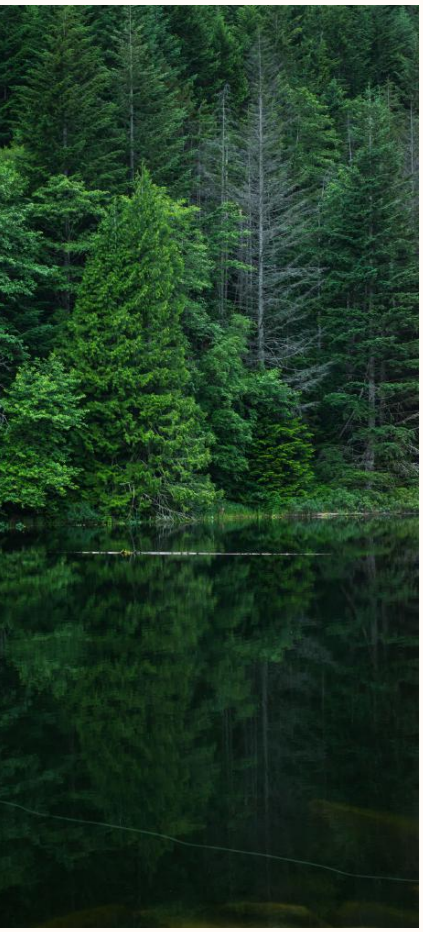
- improves air quality by producing oxygen and trapping air pollutants through trees
- reduces biodiversity loss by supporting abundant . ora and fauna in forests
- mitigates climate change by accumulation of carbon in forest soil and trees (dry tree mass is 50% carbon)
- prevents soil erosion by fixing the soil with forest floor and vigorous tree root systems
- reduces flooding as trees make a natural barrier to water streams and slow them down



2 Economic Development

Economically sustainable forestry standards correlate tree harvesting with forest preservation and consider the commercial interests of all involved parties. The economic aspect of sustainable forestry improves:

- possibilities of employment
- rise of the population's income
- trade relationships between countries
- attraction of investments, and more



3 Social Development

Socially sustainable forestry methods aim to perform the following tasks:

- improve living standards of local communities that rely on forests for a living
- offer forestry-related jobs addressing unemployment
- meet work safety requirements in forests
- ensure gender and race equity, labor rights, and other social securities

SFM Practices

Afforestation and reforestation enlarge forest areas on our planet

Replanting forests after harvesting contributes to ecologically sustainable forestry

Selective logging and thinning prevent from felling the entire stand

Some text

The ability to distinguish and treat tree diseases or pest infestations empowers forestry managers to save their farms and mitigate losses

Satellite monitoring enables remote control of the forest state and timely response to deviations

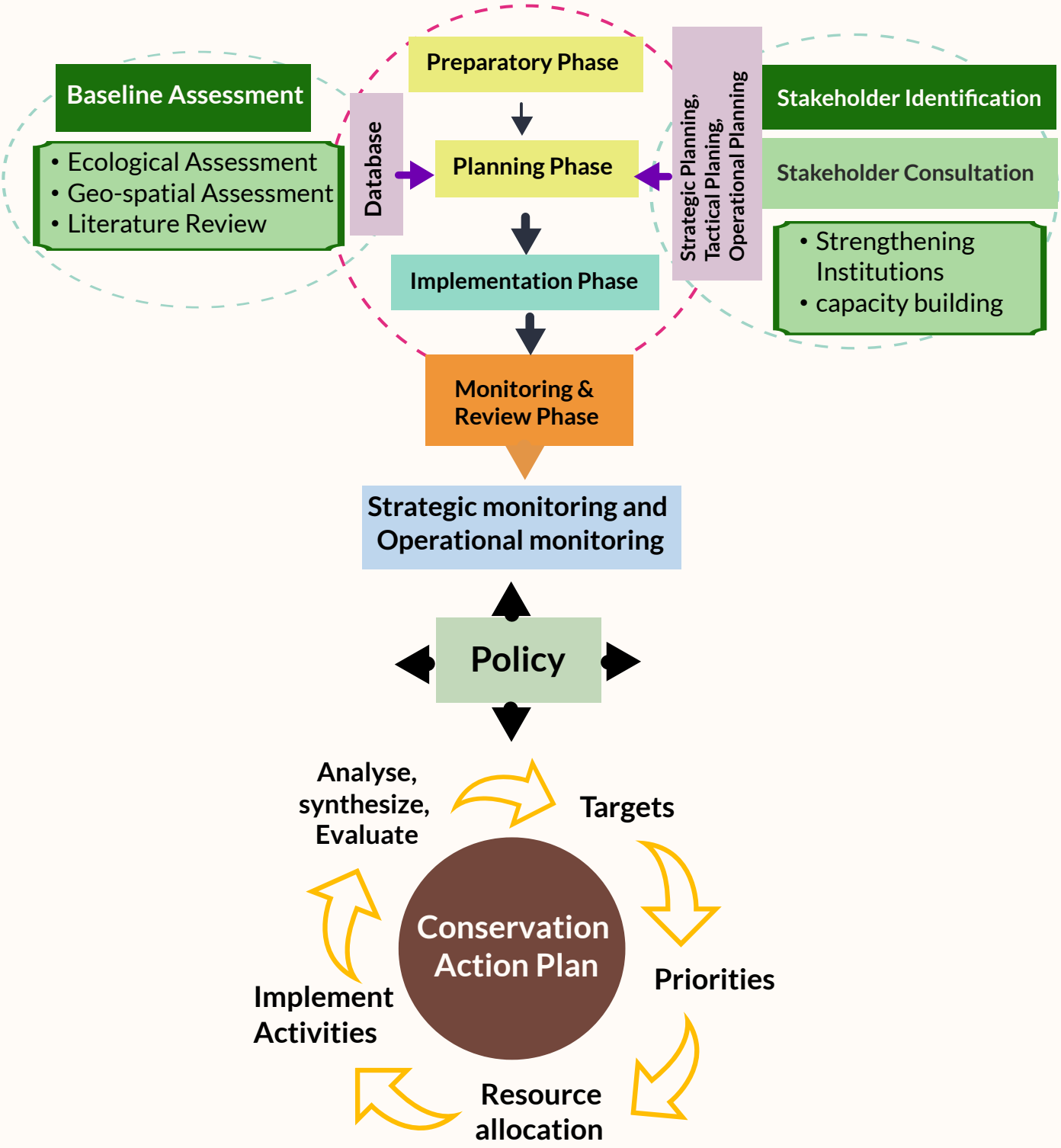
Pruning saves from logging the whole trees for wood and stops pathogens spreading

Clear cutting or removal of mature trees contributes to forest health and stimulates offspring growth

Specific training boosts foresters proficiency in sustainable forestry techniques

Prescribed burning naturally revive forests – on condition the process does not go beyond control

FRAMEWORK FOR BASIN LEVEL CONSERVATION PLANNING FOR FOREST



Preparatory Phase

The legal and policy framework, as well as the land qualities, must be analysed before the exact location and desired uses of an area can be determined, with input from stakeholders. Its outcomes are only indicative and are to be fine-tuned at a lower scale (Lescuyer and Fines, 1999). The development potential for a site can be determined and a management organisation can be chosen based on this suggestive socio-economic and ecological assessment. The first priorities and objectives for the site can be identified in collaboration with the management organisation, which has its own vision and ambitions.

Planning Phase

The development of an forest management plan (FMP) takes place at multiple levels of planning, such as strategic, tactical, and operational planning, depending on the extent of activities for the site or area specified in the preparatory phase (in figure). The strategic planning is the basis for the two other planning phases.

Strategic planning focuses on long-term goals and serves as the foundation for decisions about management goals, land allocation, and forest services. The most crucial aspect is land use planning. Following that, the various uses of the forest must be tailored to the demands of society. The questions are what can be done with the forest (options; land evaluation) and what will be done with the forest (choice; land use planning). It must be identified how to transform the current state of the forest into the intended state, as well as whether the chosen aims are possible.

Tactical planning outlines managerial operations to be carried out over the next few years in order to achieve the strategic plan's goals. It concentrates on the implementation of these actions as well as scheduling decisions. This is midterm 5 years planning.

Operational planning focuses on actual implementation of management activities and practices. This one-year operational plan will help strategic and tactical plans to be fine-tuned (Higman, 1999). Budgeting is included, and it is also referred to as the implementation level.

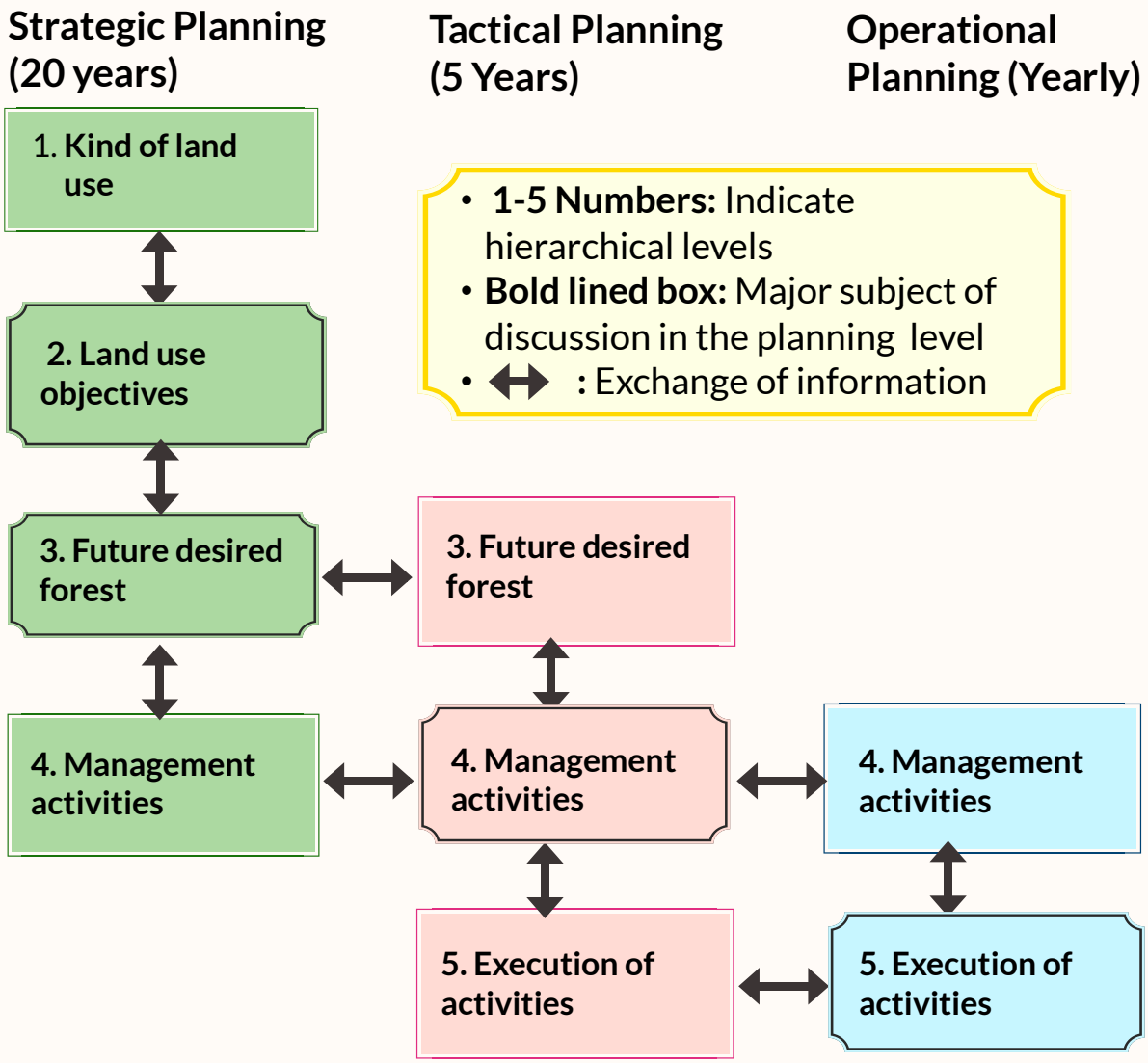


Figure: Relationship between strategic, tactical and operational planning (derived from Bos, 1994)

Implementation Phase

The above-mentioned general planning guides the implementation of management actions, which must be altered based on the results of the monitoring and evaluation process. Following the determination of operational objectives, appropriate activities, and priorities, a workplan for the entire project period, as well as annual plans, must be prepared. During implementation, the planning guidelines should be followed as closely as possible.

Monitoring & Review Phase

Monitoring and evaluating an FMP's implementation is critical. Management is a continuous process. During the execution of management, circumstances and insights may change, or assumptions may prove to be erroneous. The impacts of management should be the objective of monitoring. A monitoring programme should be developed during the planning phase to allow for regular modi. cations to planning and execution based on monitoring data.

Two levels of monitoring and review phase are classified:

1. **Operational monitoring:** It is intended at completing actions that have been identified in the operational planning. It determines if intended practises are properly carried out or whether the results of implementation are as expected. The operational plan must include clear performance metrics. This type of monitoring is usually done once a year.
2. **Strategic monitoring:** It is far more comprehensive. As circumstances change and new information, technology, and ideas become available, long and medium-term objectives must be reviewed and updated to reflect the new information. This monitoring must be done every five to ten years. Milestones will be established in the management plan to enable for proper monitoring.

FMP and Stakeholders

The participation of all stakeholders play most important role in its success. Stakeholders are all officials of urban local bodies and forest department, institutions, social groups and individuals who possess a direct, significant and specific stake in a certain area. Any sustainable forestry activity based on shared duties of professional groups with legal power over state-owned forests and the people who live in and around these forests is referred to as **collaborative forest management.**

Methods vary depending on the management purpose and interests, as well as the capacity and power of stakeholders, to build a plan in collaboration and achieve comprehensive ownership. All of these methods, including information exchange and awareness, cooperative labour, negotiation, and mediation, can be used. However, only plans that are appealing to everyone and demonstrate minimal losses should be suggested and debated in order to create confidence. During the development of the management plan, stakeholders' participation should be practised on a regular basis. For continuous societal approval, this should be maintained throughout implementation and review.

Government Initiatives

In India the national and state governments are jointly driving the sustainable management of the forest resources. In practical sense, forest departments serve as stewards of public forest resources and manage forest resources in accordance with the forest management plans. Government has initiated several measures to increase forest and tree cover.

The following are some of the most important Indian environmental, forestry, and trade laws and regulations.

I. National Afforestation Program (NAP)

The NAP Scheme began in 2006 and aims to support the ongoing process of devolving forest protection, management and development functions to decentralized institutions of Joint Forest Management Committee (JFMC) at the village level, and Forest Development Agency (FDA) at the forest division level. The overall objective of the scheme is to develop the forest resources with people's participation, with a focus on improving the livelihood of the forest-fringe communities, especially the poor.

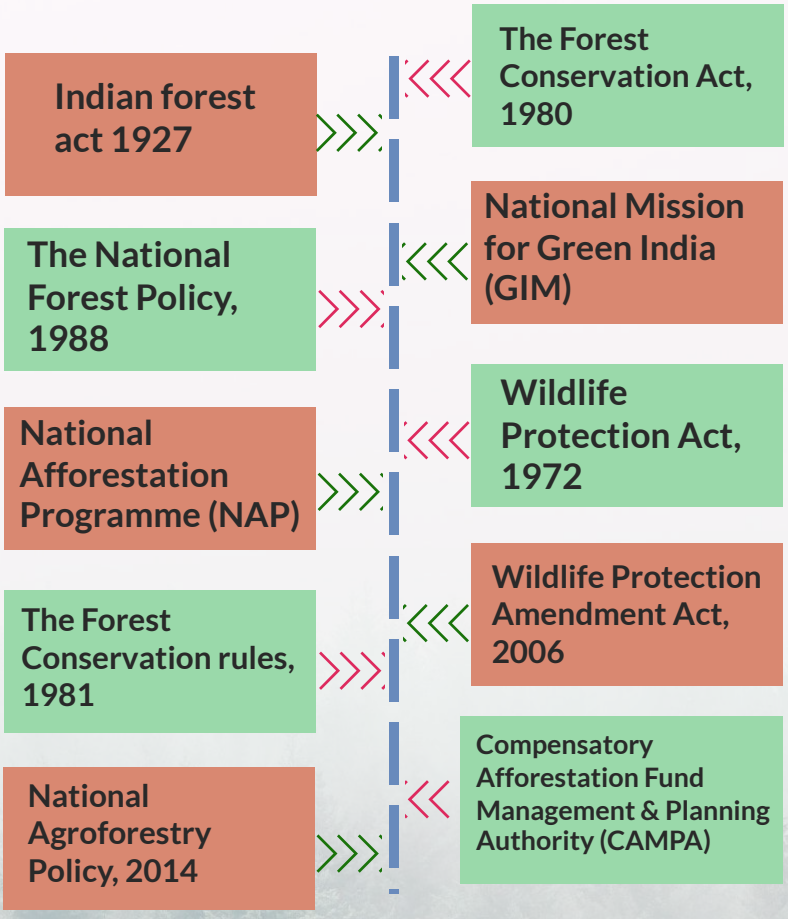


Figure: Major Initiatives of Government in forestry

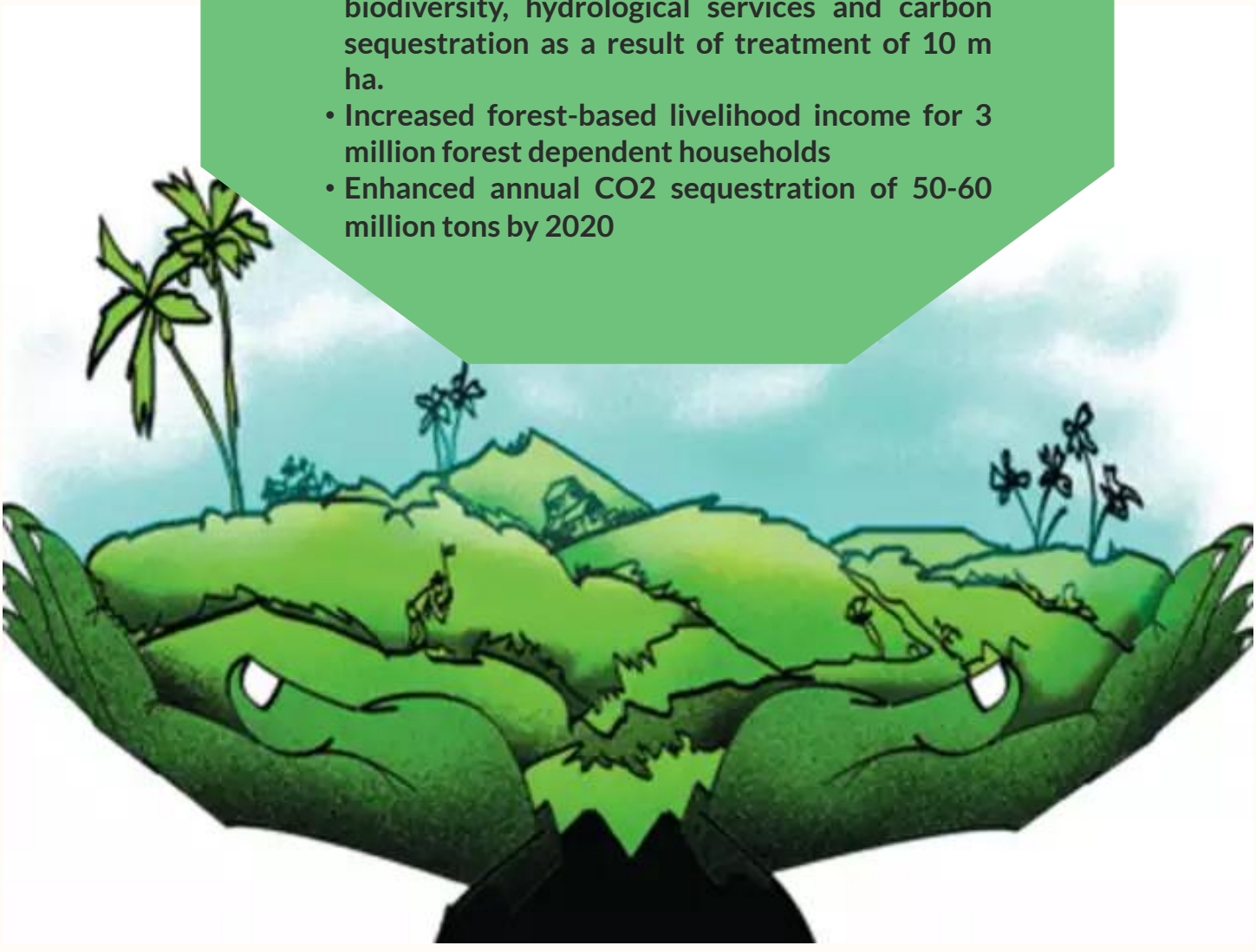
II. National Mission for Green India (GIM)

One of the eight national missions of the government under its National Action Plan on Climate Change, GIM is a 10-year program aimed at improving the quality of ve million hectares of degraded forests and bringing another ve million hectares of non-forest areas under forest cover through social and farm forestry.

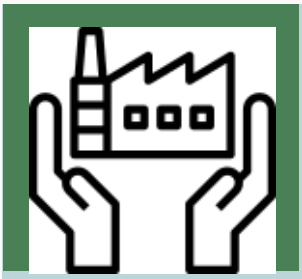
In 2014 the Cabinet Committee on Economic Affairs (CCEA) has approved an expenditure of Rs 13,000 crore (US$2.1 billion) on plantation and forest restoration in the country over the next ve years, marking the beginning of the programme.

National Mission for Green India (GIM) Objectives

- **Increase forest/tree cover (afforestation) over 5 million ha, as well as improve quality of forest cover on another 5 million ha (a total of 10 million ha)**
- **Improved ecosystem services including biodiversity, hydrological services and carbon sequestration as a result of treatment of 10 m ha.**
- **Increased forest-based livelihood income for 3 million forest dependent households**
- **Enhanced annual CO2 sequestration of 50-60 million tons by 2020**



Compensatory Afforestation Fund Management and Planning Authority (CAMPA)



It was established in 2009 as a National Advisory Council under the chairmanship of the Union Minister of Environment & Forests for the monitoring, technical assistance and evaluation of compensatory afforestation activities.

OBJECTIVES

To promote afforestation and regeneration activities as a way of compensating for forest land diverted to non-forest uses.

National CAMPA Advisory Council has been established as per orders of The Hon'ble Supreme Court with the following mandate:

- Lay down broad guidelines for State CAMPA.
- Facilitate scienti c, technological and other assistance that may be required by StatE CAMPA.
- Make recommendations to State CAMPA based on a review of their plans and programmes.
- Provide a mechanism to State CAMPA to resolve issues of an inter-state or Centre-State character.

They utilize the funds collected for undertaking compensatory afforestation, assisted natural regeneration, conservation and protection of forests, infrastructure development, wildlife conservation and protection.

Atmanirbhar Bharat Abhiyan

Aatmanirbhar Bharat Abhiyan is the mission started by the Government of India on 13th May 2020, towards making India Self-reliant. The Hon'ble Prime Minister, Shri Narendra Modi announced an economic package of INR 20 lakh crore as aid to support the country in the times of pandemic. Five pillars of Aatma Nirbhar Bharat – Economy, Infrastructure, System, Vibrant Demography and Demand. In that plan worth Rs 6,000 crore would be approved shortly under the Compensatory Afforestation Fund Management and Planning Authority (CAMPA).

CAMPA funds of Rs 6,000 crore for tribal employment in forestry jobs

Funds to be used by state government for :

- **Afforestation and plantation works, including in urban areas.**
- **Artificial regeneration, assisted natural regeneration.**
- **Forest management , soil & moisture conservation works**
- **Forest protection, forest & wildlife related infrastructre development, wildlife prtection & management etc.**

Will create job opportunities in urban, semi-urban and rural areas.

Will create job opportunities for Tribals or Adivasis in the areas of afforestation and regeneration. **(This scheme is being a special push so that the tribals and adivasis have money in their hands)**

NMCG Initiatives

1. **Forestry Interventions for Ganga**

National Mission for Clean Ganga, the implementing arm of 'Namami Gange' program has embarked on a mojor afforestation drive within 5kms on each side of the river ganga in the ve riparian states in association with state forest department and enlisting the support of other central and state government departments or NGOs.

The forestry intervention under Namami Gange has started in the year 2016-2017. Initially project duration is for ve years. It is aimed to enhance the productivity and diversity of the forest in headwater areas along the river Ganga and its tributaries. This holistic approach emphasises appropriate interventions such as afforestation, habitat management, catchment treatment-soil and moisture conservation, restoration of critical riparian forest buffers, improved livelihood of forest dependent communities and forest dwellers, and alternative income-generating activities. Key components of forestry intervention are afforestation activities in natural, agricultural and urban landscapes by way of plantation in the ve states of Ganga riverscape including conservation of soil and water, riparian wildlife and wetland management. The project envisages the plantation of 4 crore native tree species along the stretch of the Ganga in Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal over a period of ve years.

The major act will be seen in increased recharge of aquifers, reduced erosion and improvement in river health ecosystem.

Plantation activity at a glance from 2016-17 to 2018-19

State	Total Plantation Done (in no.)	Total funds sanctioned (Rs. in crore)	Funds utilized (Rs. in crore)
Uttarakhand	3677287	63.9907	50.73
Uttar Pradesh	2861879	40.5135	19.33
Bihar	499138	45.6182	35.59
Jharkhand	735187	20.1266	14.83
West Bengal	1677981	29.7333	12.13
Total	94,52,412	199.60	132.61

Major Green Interventions under Forestry Programme

- Soil & Moisture conservation works
- Preparation of Trenches/Pits
- Developing samplings & plants in nurseries
- Plantation activities in identified areas - medicinal & other plants.
- Developing Eco-parks along Ganga river banks
- Public outreach activities including tree planting campaigns
- Distribution of plants amongst farmers villagers & forest dwellers.
- Public outreach programmes (Jan abhiyaan) & community plantation.

2. Biodiversity Conservation and Ganga Rejuvenation

One of NMCG's long-term visions for Ganga rejuvenation is to restore viable populations of all endemic and endangered biodiversity of the river, so that they occupy their full historical range and ful l their role in maintaining the integrity of the Ganga river ecosystems.

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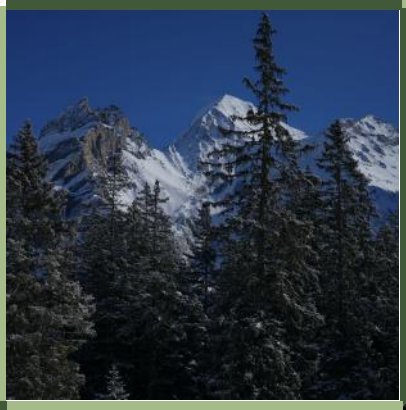

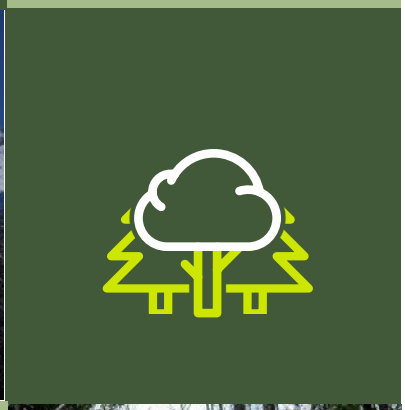

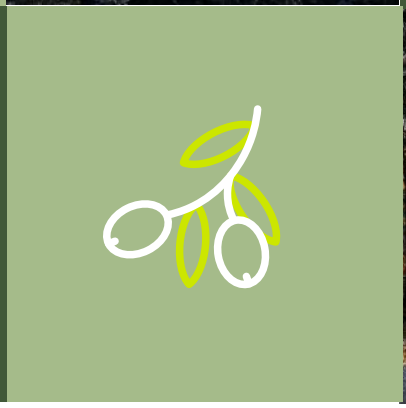

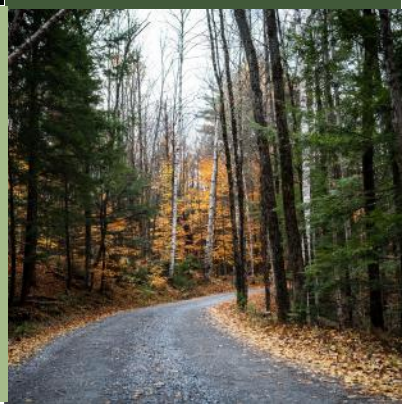

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