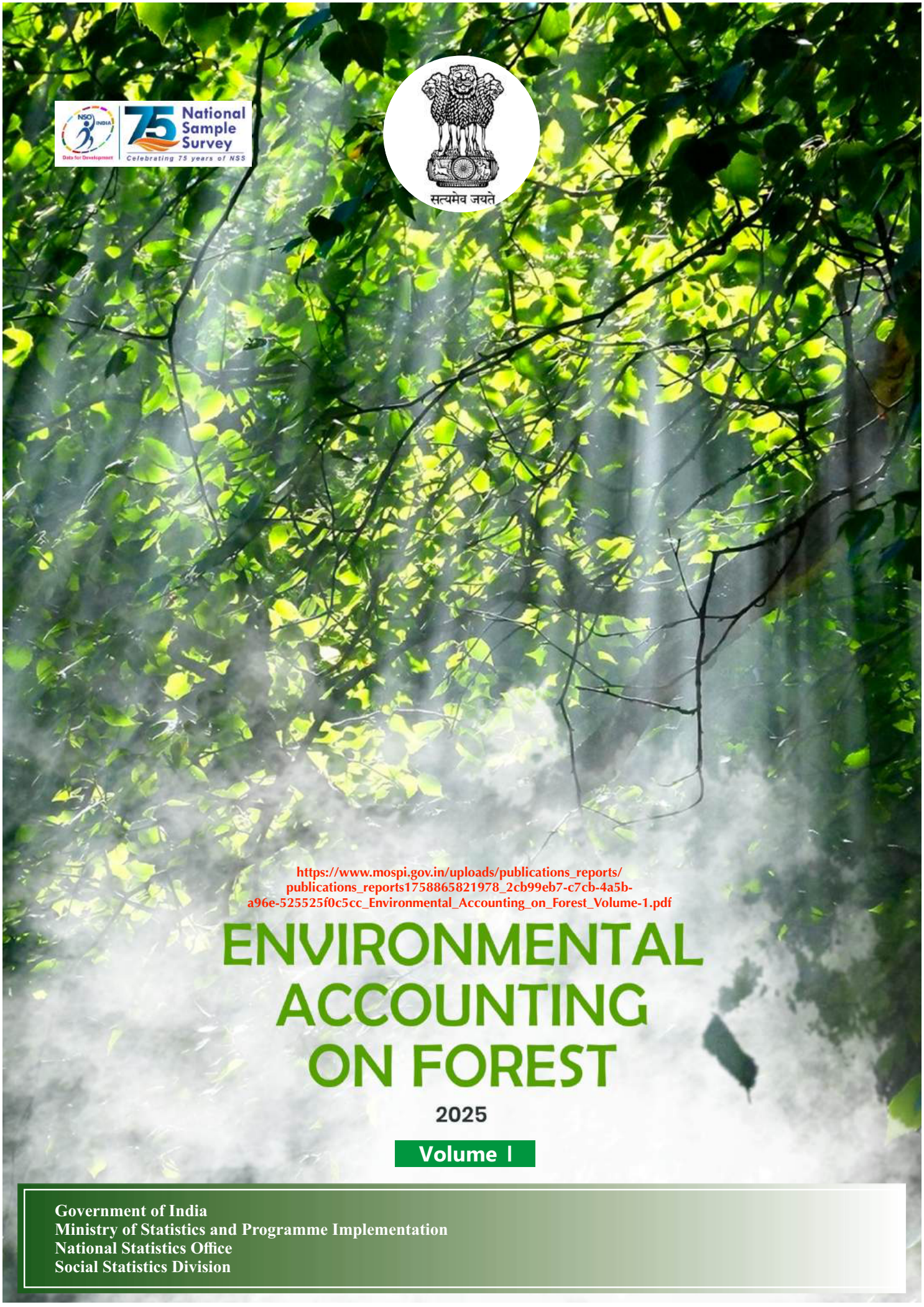

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ENVIRONMENTAL ACCOUNTING ON FOREST

2025

Volume I

Government of India
Ministry of Statistics and Programme Implementation
National Statistics Office
Social Statistics Division

ENVIRONMENTAL

Accounting on Forest- 2025

Volume I

Government of India
Ministry of Statistics and Programme Implementation
National Statistics Office
Social Statistics Division

Acknowledgement

The Division gratefully acknowledges the invaluable support of the Ministry of Environment, Forest and Climate Change (MoEFCC), along with its affiliated institutes and organizations. This publication, presenting comprehensive forest accounting information, would not have been possible without their contributions. Special appreciation is extended to the officers and team involved in the preparation of the India State of Forest Report (ISFR), which served as the primary data source for this publication.

Access Soft Copies of this report and the tables contained therein are available for download, free of charge, from: https://www.mospi.gov.in/download-reports. The updated information is available in the pdf version of the publication. Few time series information can be downloaded from the excel file.

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The contents of this publication are intended to enhance public access to information about Environmental accounting of Forests as per System of Environmental Economic Accounting (SEEA) framework.

This material has been compiled using information drawn from publications, research studies/reports/papers, and official websites of the relevant Ministries/Departments and their affiliated institutions, as well as various agencies of State/UT Governments and international organizations. Every effort has been made in preparing this publication to ensure correctness of information. The National Statistics Office (NSO) accepts no responsibility for the differences between the stated figures and those published elsewhere. Due to the dynamic changes in the datasets, users are requested to check for updates with the source agencies.

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Feedback and suggestions for the publication are welcomed by the Environment unit team at ssd-mospi@gov.in

राव इन्द्रजीत सिंह
RAO INDERJIT SINGH

सत्यमेव जयते

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भारत सरकार
Minister of State (Independent Charge) of the
Ministry of Statistics and Programme Implementation;
MOS (I/C) of the Ministry of Planning and
MOS in the Ministry of Culture
Government of India

MESSAGE

I am delighted to release the first dedicated publication on forest titled "Environmental Accounting on Forest -2025", prepared in line with the System of Environmental-Economic Accounting (SEEA CF and SEEA EA). This initiative holds immense significance in today's context, where environmental sustainability forms the foundation of balanced and equitable development.

Forests are one of our country's most valuable natural assets, providing critical ecosystem services ranging from climate regulation to livelihood support. Understanding these contributions through a structured accounting framework is vital for designing evidence-based policies and ensuring that developmental growth is aligned with our environmental commitments.

This publication presents a comprehensive overview of decadal changes in India's forests, facilitating an understanding of long-term trends in forest cover, condition, and resource utilization. It highlights gains or losses in forest assets, area, and changes in ecosystem services. It also provides sub-national information in forest accounting for capturing regional variations. Such efforts help strengthen our knowledge base and create opportunities for more informed decision-making in support of the Sustainable Development Goals.

I congratulate the officers of the Ministry of Statistics and Programme Implementation for their timely and rigorous efforts in preparing this important document. My sincere appreciation is also extended to all collaborating Ministries, Departments, and stakeholders whose contributions made this publication possible.

I am confident that this edition will serve as a valuable resource for policymakers, researchers, and practitioners, while also enriching the national dialogue on environmental sustainability and forest conservation.

(Inderjit Singh)

12 September, 2025.

New Delhi

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सचिव

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Secretary

सत्यमेव जयते

National Sample Survey

भारत सरकार
सांख्यिकी एवं कार्यक्रम कार्यान्वयन मंत्रालय
Government of India
Ministry of Statistics & Programme Implementation

Message

I am happy to present the publication titled *"Environmental Accounting on Forests – 2025,"* which marks a significant milestone in recognizing the value of India's forest resources. Forests are one of the most multifunctional ecosystems, providing a wide spectrum of ecological, economic, social, and cultural services, and through its benefits, support life on Earth. This publication provides a thorough decadal analysis of forest extent, condition, asset value, and ecosystem services at both national and sub-national levels. By integrating these components into a cohesive accounting framework, it highlights the critical ecological and economic roles forests play, helping to inform effective policy-making and promote sustainable management.

In addition to national-level insights, the publication also reviews **existing initiatives on ecosystem accounting** undertaken in selected States/UTs by Forest Departments, research institutions, and other stakeholders. These studies serve as useful references for understanding the progress, challenges, and potential pathways for strengthening forest and ecosystem accounting practices across India.

The publication could take its final shape largely due to the timely cooperation and inputs provided by the line Ministries and Departments. I also acknowledge the dedicated efforts of officers of the Social Statistics Division for compiling and bringing out this valuable document within a demanding timeframe.

I hope this publication will serve as a valuable reference for government bodies and other stakeholders involved in environmental planning, natural resource management, and the advancement of sustainable development initiatives.

Saurabh Garg

(Dr. Saurabh Garg)

New Delhi
September 10, 2025

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FOREWORD

The National Statistical Office has remained committed to producing high-quality environmental data that serves as a foundation for evidence-based policy and planning. In this context, the publication **"Environmental Accounting on forest -2025"** represents a pioneering effort to systematically present the extent, condition, asset value, and ecosystem services of India's forests at national and sub national level It also includes a literature review for select States/UTs, explores possibilities for integration in future editions, and outlines reference levels for the indicators used in forest accounting. This initiative reflects our continued effort to strengthen the statistical base for environmental governance and sustainable development.

The preparation of this publication has been possible due to the timely contributions of participating Central Ministries, Departments, and Organizations, whose data formed the backbone of the accounts. I sincerely acknowledge their collaboration and extend my appreciation to the officers of the Social Statistics Division, Ministry of Statistics and Programme Implementation, for their rigorous work under the capable leadership of Sh. S.C. Malik, Additional Director General. Their dedication has ensured that this first edition provides an integrated perspective on the role of forests in both the economy and the environment.

I am confident that this publication will serve as a valuable reference for policymakers, researchers, and stakeholders engaged in forest management, environmental policy, and sustainable development. I also welcome feedback and suggestions from readers, which will be instrumental in further enhancing the scope and quality of future editions.

(N. K. Santoshi)

New Delhi
08th September, 2025

सुभाष चन्द्र मलिक, भा.सां. से
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Additional Director General

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Preface

Forest accounting, though a relatively new area within official statistics in India, is increasingly being recognized for its critical role in guiding sustainable development and environmental management. Forests not only provide tangible resources but also deliver vital ecosystem services such as carbon sequestration, biodiversity support, and livelihood security. By presenting data on the extent, condition, asset values, and ecosystem services of forests, this publication "Environmental Accounting on Forest-2025" aims to provide a comprehensive framework for quantifying the multiple contributions of forests to both the economy and the environment.

8th edition related to environment accounts and first dedicated edition on forest has been prepared in line with the System of Environmental-Economic Accounting (SEEA CF and SEEA EA), drawing upon data from multiple Ministries, Departments, and Organizations.

The publication has been compiled by the social Statistics Division (SSD) of MoSPI under the leadership of Ms. Anita Baghel, Deputy Director General, whose guidance and technical insight has been instrumental in shaping this report. I also extend my sincere appreciation to the entire SSD team of officers who have worked with commitment to bring out this publication in time.

I gratefully acknowledge the valuable contribution of all stakeholders in providing data and insights that have enriched the accounts. I deeply value the dedicated contribution of the technical committees, whose guidance has been instrumental in shaping this publication.

It is my sincere hope that this publication will serve as a valuable reference for policymakers, researchers, and practitioners engaged in environmental conservation and sustainable development. As this is the first edition dedicated exclusively to forests, I welcome feedback and suggestions from readers, which will be invaluable in enhancing the scope and quality of future editions.

(S. C. Malik)

New Delhi
September, 2025

अनीता बघेल, भा.सां. सेवा
उप महानिदेशक
Anita Baghel, I.S.S.
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सत्यमेव जयते

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Ministry of Statistics & Programme Implementation

Acknowledgement

This publication, "Environmental Accounting on Forest-2025", marks the first edition in a series dedicated to presenting comprehensive and integrated information on India's forest resources. Structured in line with the System of Environmental-Economic Accounting (SEEA CF and SEEA EA), it provides a detailed account of forest extent, condition, asset values, and the ecosystem services they deliver. As one of the country's most valuable natural resources, forests play a crucial role in climate regulation, biodiversity conservation, and the generation of livelihoods. This publication seeks to highlight these contributions in a systematic and measurable framework.

I take this opportunity to express my heartfelt gratitude to Dr. Saurabh Garg, Secretary, Ministry of Statistics and Programme Implementation (MoSPI), Sh. N.K. Santoshi, Director General (Central Statistics), MoSPI, and Sh. S.C. Malik, Additional Director General, Social Statistics Division, MoSPI, for their visionary leadership, consistent guidance, and steadfast support, which have been pivotal in bringing out this publication. I also extend my sincere appreciation to the Central Ministries, Departments, and Organisations whose collaboration and timely data inputs formed the foundation of this work.

I am deeply grateful to the members of the Interministerial Group on Environmental-Economic Accounting and the members of the Expert Group on Environment Statistics for their invaluable insights, which have greatly enhanced the depth and quality of this publication. Furthermore, I would like to express my sincere gratitude to Dr. Haripriya Gundimeda of IIT Bombay for her valuable technical support in exploring new ideas for this report. I also extend my appreciation to Dr. Rajeev Pandey (ICFRE) and Dr. T.V. Ramachandra (IISc) for their insightful guidance on various aspects of the study. I would also like to acknowledge the dedication and commitment of especially, Ms. Kirti Gaikwad – Joint Director, Ms. Neha Singh- Deputy Director, Ms. Kulpreet Sokhi-Senior Statistical Officer, Ms. Nikita Kumari- Junior Statistical Officer, Shri Rajeev Roshan-Junior Statistical Officer, Ms. Priya Mishra- Consultant, Dr. Shivani Sinha- Consultant, whose focused efforts made this publication possible within the scheduled timeframe.

I hope this publication will serve as a helpful resource for planners, policymakers, researchers, and academicians working towards forest conservation and sustainable development. Feedback and suggestions from readers will be valuable in improving and broadening the scope of subsequent editions.

(Anita Baghel)

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Abbreviations

AGB	Above-Ground Biomass
BGB	Below-Ground Biomass
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CICES	Common International Classification of Ecosystem Services
CUM	Cubic Meter
DCU	data collection unit
ECT	Ecosystem condition Typology
EFGs	Ecosystem Functional Group
ENS	Effective number of species
EXP	Exponential
FAO	Food and Agriculture Organization
FRA	Forest Rights Act
FSI	Forest Survey of India
GA	Geographical Area
GDP	Gross Domestic Product
GIS	Geographic Information System
GPG	Good Practice Guidance
GVA	Gross Value Added
GVO	Gross value of Output
HA	Hectare
ICFRE	Indian Council of Forestry Research and Education
IDF	International Day of Forests
IPCC	Intergovernmental Panel for Climate Change
ISFR	India State of Forest Report
ISIC	International Standard Industrial Classification of All Economic Activities
IUCN	International Union for Conservation of Nature
LUS	Land Use Statistics
MDF	Moderately Dense Forest
MIS	Management Information System
MoAFW	The Ministry of Agriculture and Farmer's Welfare

Abbreviations

MODIS	Moderate Resolution Imaging Spectro-radiometer
MoEF&CC	Ministry of Environment, Forest & Climate Change
MoSPI	Ministry of Statistics and Programme Implementation
MSUT	Monetary Supply and Use Tables
NCAVES	Natural Capital Accounting and Valuation of Ecosystem Services
NDC	Nationally Determined Contributions
NPA	Non-Performing Asset
NTFP	Non-timber forest products
NTUs	Nephelometric turbidity units
OF	Open Forest
PF	Protected Forest
PSUT	Physical Supply and Use Tables
RF	Reserved Forests
RFA	Recorded Forest Area
SCC	social cost of carbon
SDGs	Sustainable Development Goals
SEEA CF	System of Environmental-Economic Accounting Central Framework
SEEA EA	System of Environmental-Economic Accounting – Ecosystem Accounting
SFDs	State Forest Departments
SGDP	State Gross Domestic Product
SNA	System of National Accounts
SNPP-VIIRS	Suomi National Polar-orbiting Partnership - Visible Infrared Imaging Radiometer Suite
SOC	Soil Organic Carbon
T C/HA	Tonnes of Carbon per Hectare
TOF	trees outside forests
UNESCO	United Nations Educational, Scientific and Cultural Organization
VDF	Very Dense Forest
WAVES	Wealth Accounting and Valuation of Ecosystem Services
WTA	Willingness to Accept
WTP	Willingness to Pay

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Forests are one of the most significant natural assets of any country, offering a wide array of ecological, economic, and social benefits. In India, forests contribute not only to environmental stability but also to livelihoods, climate resilience, and biodiversity conservation. Recognizing their multifaceted value, there has been a growing emphasis on capturing the true contribution of forests through structured and comprehensive accounting. India's forests are ecological treasures and critical assets that support the nation's environmental stability, economic development, and social well-being. This report is compiled as a dedicated effort to present an integrated statistical perspective on the country's forest resources-moving beyond fragmented reporting toward a unified, analytical framework. By consolidating physical, monetary, and ecological dimensions of forest accounts, the book offers a structured foundation for understanding how forests contribute to the economy, biodiversity, and climate goals.

This publication presents a comprehensive and standalone account of forests in India, prepared in alignment with the internationally recognized System of Environmental-Economic Accounting (SEEA). It marks a significant advancement in the statistical integration of environmental and economic data, with a specific focus on forests, an essential component of the country's natural capital.

Forest-related statistics were previously included in the EnviStats India: **Volume-II publication** series of the **Ministry of Statistics and Programme Implementation (MoSPI)**, which provides environmental accounting related information on various themes such as land use, water, and biodiversity. Forest accounts were specifically addressed in EnviStats India: **Volume-II** editions of **2018, 2020, and 2022**, offering important insights into forest resources within the broader framework of environmental statistics. However, this publication presents, for the first time, a **dedicated, compiled, and detailed volume** exclusively focused on forest accounts. This enables a more structured and in-depth presentation of data across multiple dimensions of forest account such as extent, condition, assets, and services.

This report draws conceptually from the internationally accepted **SEEA Central Framework (SEEA-CF) and SEEA Ecosystem Accounting (SEEA-EA)**, which provide the internationally recognised framework for environmental-economic accounting. These frameworks guide the integration of environmental data with economic statistics and support the measurement and monitoring of stocks, their ecological condition, and the ecosystem services they provide. Their application ensures consistency, comparability, and alignment with global statistical standards. In this report, forest-related components from these frameworks have been carefully drawn, simplified for better understanding, and adapted to the Indian context.

The publication utilizes data from trusted national sources, including the India State of Forest Report (ISFR), the Forest Survey of India (FSI), and the Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project and Forestry statistics of India 2021, ICFRE.

This report covers the following four main types of forest accounts:

1. Forest Extent Account: It captures the extent of forest resources by considering the total recorded forest area. It shows the opening and closing stock of recorded forest area and helps track spatial changes, whether increases or decreases, over time. This account uses a few key indicators such as Recorded Forest Area and forest area according to type of protection. Monitoring forest extent is essential for understanding land use dynamics and planning sustainable forest management.

2. Forest Asset Account: It considers forests as renewable natural assets. It records the opening and closing stock of forest cover within a given period, reflecting both additions and reductions. Forest asset accounting helps in the sustainable use of forest resources, includes the value of forests in the country's economy, and provides clear information for making better decisions about forest management and planning.

3. Forest Condition Account: The Condition Account captures the condition of forests- how well they are functioning and able to support life and economy. It checks how forests help in supporting biodiversity, storing carbon, and restoration. The condition of forests can be understood by looking at different states, i.e., physical, chemical, compositional, structural, functional, and landscape. To assess different aspects of forest condition we use selected indicators under six key state categories; Physical state covers indicators like Growing Stock, which reflect physical characteristics and disturbances. Chemical state covers indicators like Carbon Stock, indicating the chemical composition of forest biomass. Compositional state covers indicators like Invasive Species and Biodiversity Assessment, capturing changes in species diversity and composition. Structural state covers indicators like, Dead Wood (as part of Carbon Stock) and Wetland, while Function state covers indicators like Regeneration Status and Biotic Influence to assess the forest's natural growth processes and pressures affecting them. Landscape state considers Forest Patches, highlighting spatial patterns and connectivity across the landscape.

4. Forest Services Account records the monetary flow of services provided by forests that contribute to society and the economy. In the SNA accounting, these services are not included leading to undervaluation of forest resources, especially for non-market services. The key services included are: Timber Provisioning Services (such as industrial wood), Non-Timber Provisioning Services (as fuelwood, fruits, honey, medicinal plants, and bamboo),

Carbon Retention Services (forests absorb and store carbon dioxide, helping regulate the climate), Eco-tourism (benefits from recreation and tourism activities in forest areas). In line with the SEEA Ecosystem Accounting (SEEA EA) framework, for evaluating Provisioning services (timber and non-timber) market-based mechanisms, such as the production approach and exchange rate, have been used. Further, Carbon services are valued using non-market mechanism such as social cost of carbon through benefit-transfer approach.

Key Findings

This report presents decadal changes of forest extent, condition, assets, and ecosystem services in India, based on standardized accounting frameworks and nationally validated data sources. The key findings reflect encouraging trends in forest health and management, alongside areas that require attention for future planning and restoration. Major findings are summarized below-

1. Physical Asset Account: Between 2010-11 and 2021-22 India's forest cover has shown notable growth of 22.75%, in the very dense forest category showing strengthening of the country's ecological resources. Open Forests and Scrub also grew slightly, indicating some recovery. A 0.76% drop in non-forest areas suggests positive land-use change toward forest.

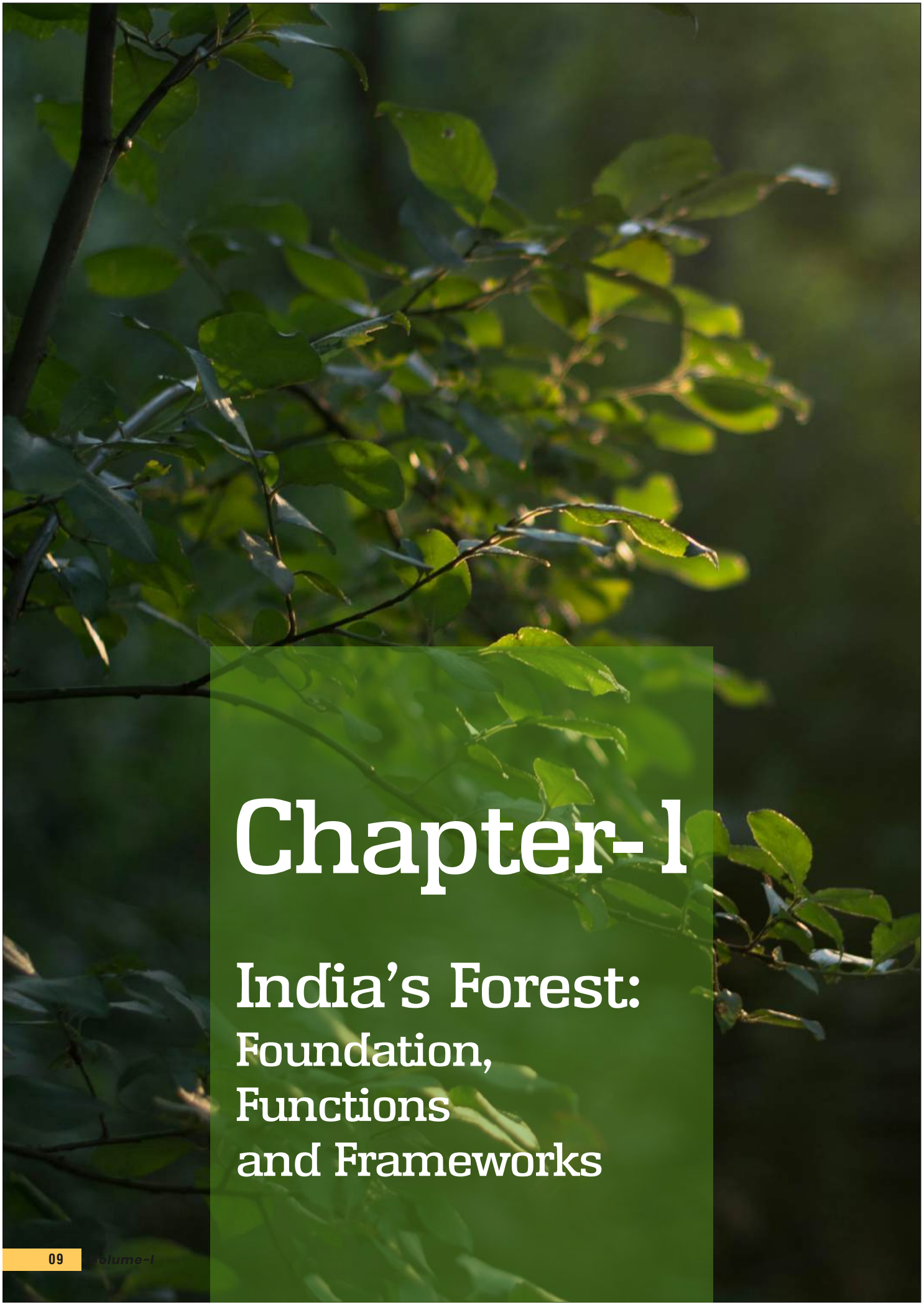
2. Extent Account: The extent of forest area in India is assessed based on the Recorded Forest Area (RFA), which comprises all land legally notified as forest, regardless of actual tree cover or canopy density forest cover or canopy density. During the last decade (2013-2023)[1], RFA has slightly increased from 23.48% to 23.59%, moving slowly towards the achieving of the national target.

3. Condition Account: The condition of India's forests has improved in terms of biomass and carbon storage, with reduced severe degradation indicating better forest health, but declining regeneration and rising fire risks highlight vulnerabilities in forest condition that need urgent attention. During the decade (2013-2023)[1], the volume of growing stock increase by 7.32% indicating enhancement in forest's capacity in terms of timber volume and overall forest health. Further, during (2017 to 2023)[1] carbon storage improved by 2.87% and net change in carbon stock per hectare rising from 99.99 to 101.85 tonnes, surpassing the global benchmarking and strengthening the forest condition for climate resilience.

4. Ecosystem Services Account: Over the decade i.e. 2011-12 to 2021-22, the ecosystem services provided by India's forests have demonstrated notable shifts. The value of forest regulating service specially carbon retention service increased significantly by 51.82% at current prices indicating 2.63% of the GDP in 2021-22. reflecting enhanced forest condition and increasing recognition of forests' role in climate mitigation. Further, During the decade, economic value of total provisioning services(Timber +Non-Timber) provided by forest experienced a growth of 23.47% at current prices representing 0.16% of the GDP in 2021-22 . This growth reflects an enhanced supply of timber and non-timber products, supports livelihoods and food security, promotes biodiversity, and provides sustainable resources for various industries.

[1]As per assessment done by Forest Survey of India for respective years

India’s forests are showing positive trends in terms of growth, health, and climate service delivery. Strong gains in Very Dense Forests, carbon stock, legal protection, and biodiversity reflect national progress. Challenges remain in forest regeneration, invasive species, and certain forest types, which require continued attention. Going forward, mainstreaming forest accounts into regular statistical systems and improving data quality and coverage will be a key to tracking progress, informing policy, and aligning with global commitments such as the SDGs and climate goals. This effort reflects a commitment to valuing nature as a national asset and managing it responsibly for future generations.



Chapter- I

India's Forest: Foundation, Functions and Frameworks

KEY MESSAGES

- Forests are vital ecosystems that support environmental stability, economic growth, food security, and the well-being of people at all levels.

- They deliver tangible and non-tangible benefits such as storing carbon, protecting soil and water, regulating climate, and conserving biodiversity while supporting the livelihoods of millions, including Indigenous and forest-dependent communities.

- Forests ecosystem and related activities are directly or indirectly linked to Sustainable Development Goals (SDGs), making them central to the global development agenda adopted by 196 countries, including India.

- International agreements, such as the United Nations Strategic Plan for Forests 2017-2030, highlight the importance of reversing forest loss, restoring degraded forests, and boosting cooperation and resources for long-term sustainability.

- India is ranked third in the world for the highest net annual gain in forest area (2010-2020), due to large-scale restoration projects, strong community participation, and progressive agroforestry efforts, demonstrating the country's on-going commitment to forest conservation.

- India supports a diverse range of forest types 16 broad groups spanning tropical, sub-tropical, temperate, alpine, and scrubby/evergreen forests found across various regions and climatic zones, reflecting the country's ecological richness and complexity.

- Forests and tree cover in India together account for 8.27 lakh sq. km, (25.17%) of the country's geographical area, according to the India State of Forest Report 2023. Forest cover alone is 7.15 lakh sq. km (21.76%), and tree cover is 1.12 lakh sq. km (3.41%).

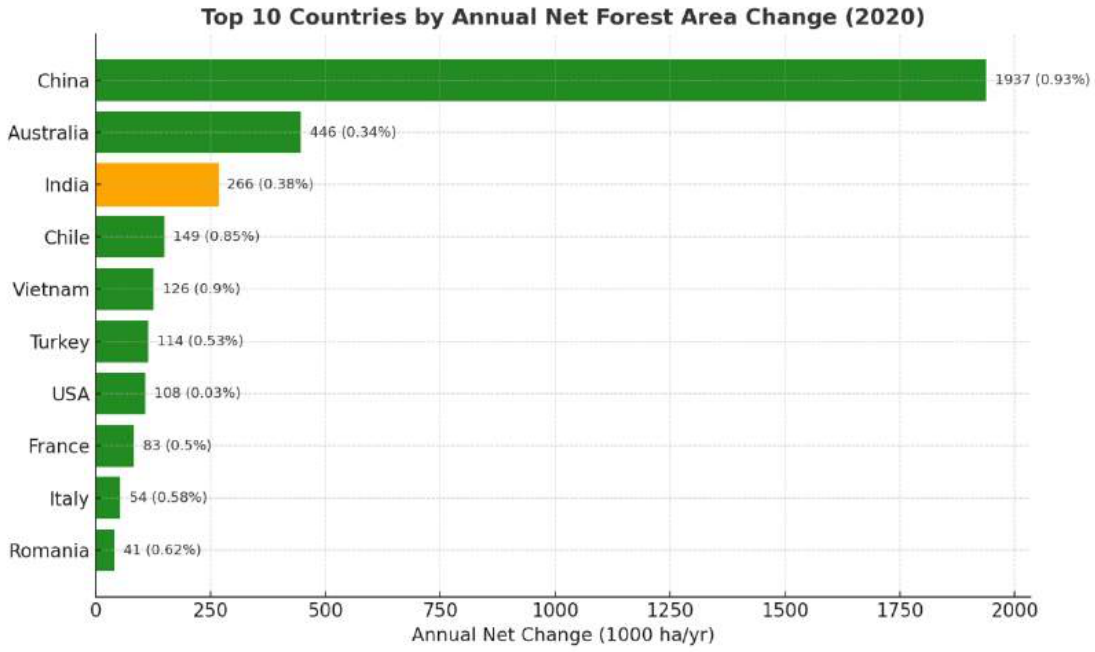
- India is a signatory to the United Nations Strategic Plan for Forests 2017-2030, which sets six Global Forest Goals and 26 voluntary targets, including reversing the loss of forest cover, enhancing forest benefits, expanding sustainable management, mobilizing increased financial resources and strengthening governance and cooperation.

Forests as an Ecosystem

1.1 The term 'Forest', as defined in the online version of Oxford dictionary, is a large area covered chiefly with trees and undergrowth. In terms of globally accepted standards, the extent of forests is denoted by 'Forest Area' by the Food and Agriculture Organization (FAO). It is defined as "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use."

According to the FAO's State of the World's Forests 2024 report, India ranked third globally in terms of average annual net gain in forest area between 2010 and 2020. During this period, India recorded an average annual increase of 266,000 hectares of forest area. Only China and Australia reported higher gains. The report also highlighted India's initiatives in restoring degraded lands and promoting agroforestry as key contributors to this positive trend.

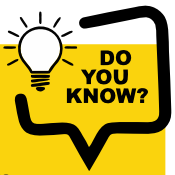
Figure 1.1 Top Ten Countries For Average Annual Net Gain In Forest Area, 2010–2020



SOURCE: FAO. 2020. Global Forest Resource Assessment 2020: Main report. Rome.

1.2 Forests are one of the multifunctional ecosystems which provide several services to humans on all spatial and temporal levels. Today, the entire world has recognized the importance of forests and trees, not only a resource base, but also as the key to survival of life on earth. The United Nations General Assembly proclaimed 21 March the International Day of Forests (IDF) in 2012. The Day celebrates and raises awareness of the importance of all types of forests. On International Day of Forests, countries are encouraged to undertake local, national and international efforts to organize activities involving forests and trees, such as tree planting campaigns. The theme for each International Day of Forests is chosen by the Collaborative Partnership on Forests.

1.3 The United Nations Organization proclaimed its theme for 2021 as "Forest Restoration: a path to recovery and well-being." The services provided by forests cover a wide spectrum of ecological, economic, social and cultural considerations and processes providing a multitude of benefits at local, national and global levels. Without the ecosystem services emanating from forests, life on earth would not be possible. Forests are vital to the global economy and ecosystem for an ample number of reasons. Not only do they provide a production function in the form of a wealth of resources, but they also play a significant role in terms of regulatory functions such as carbon sequestration and hydrological cycling. Another critical role played by forests is that of habitat provision, an essential function for more than half of the world's species which live there.



The ISFR is brought out by the Forest Survey of India (FSI) on a biennial basis since 1987.

1.4 In 2025, forests and foods is the theme for the International day of forest, celebrating the crucial roles of forests in food security, nutrition and livelihoods. In addition to providing food, fuel, income and employment, forests support soil

fertility, protect water resources, and offer habitats for biodiversity, including vital pollinators. They are essential for the survival of forest-dependent communities, particularly Indigenous Peoples, and contribute to climate change mitigation by storing carbon[2].

1.5 The relevance of the forest in the human lives cannot be undermined with forests playing a lead role in not just for timber and but also in myriad of other services such as carbon sequestration, preserving biodiversity, pollination services, soil conservation, recreational and cultural values, stabilizes flows and runoffs which in turn prevents land degradation and desertification diminishing the risks of the natural disasters such as droughts, floods and landslides.

Definition of "Forests Area and Forest Cover" across India's Official Data Sources

1.6 Definition of 'Forest Area' in Land Use Statistics (LUS): The Ministry of Agriculture and Farmer's Welfare (MoAFW) compiles and releases Land Use Statistics according to a nine- fold classification. In this dataset, 'Forest Area' includes all land classified either as forest under any legal enactment, or administered as forest, whether State-owned or private, and whether wooded or maintained as potential forest land. The area of crops raised in the forest and grazing lands or areas open for grazing within the forests remain included under the 'Forest Area'.

1.7 'Recorded Forest Area' defined by Forest Survey of India (FSI): It is defined as "all such lands which have been notified as forest under any Government Act or Rules or recorded as 'forests' in the Government Records". Recorded forest areas largely consist of areas designated as Reserved Forest (RF) or Protected Forests (PF) under the provisions of Indian Forest Act, 1927 or its counterpart State Acts. Besides these, the recorded forest area may include all such areas, which have been recorded as forests under any State Act or local laws or any revenue records.

1.8 **Definition of 'Forest Cover' as followed by the Forest Survey of India (FSI):** It includes all **lands, more than equal to one hectare in area with tree canopy density of more than or equal to 10 %** irrespective of ownership, legal status, and includes orchards, bamboos, palms.

[2]https://www.fao.org/international-day-of-forests-2025/en

1.9 Thus, 'Forest cover' indicates presence of trees on any land, irrespective of ownership of land; and irrespective of the fact whether the land is notified as a forest land or not.

1.10 The terms 'Forest Cover' and 'Forest Area' are the two most commonly used terms to describe the coverage of the forest. Both the terms, 'Forest Cover' and 'Forest Area' denote coverage of the forests with different meanings. The term 'Forest Cover' is used to define the expanse of forest resources in a region primarily based on the tree canopy density, while the term 'Forest Area' is used to denote the areas having legal standing, i.e., recorded as forests in government records or maintained as forests. In addition, there exists a variation in the definition followed by different Indian official agencies in the measurement and description of forests.

DO YOU KNOW?

India's total forest and tree cover is 8,27,357sq km, making up 25.17% of the country's geographical area according to the 2023 India State of Forest Report (ISFR)

Relevance

1.11 Trees and forests have held an important place in India since ancient times. These resources are vital for the existence of life on earth. As far as the definition of the forest cover is concerned, there exists different definitions from different sources. Evaluating the nature of the forests and monitoring their status are important from the perspective of national wealth, prosperity and economic well-being.

1.12 Forests harbour most of Earth's terrestrial biodiversity: for example, they provide habitats for about 80 percent of amphibian species, 75 percent of bird species and 68 percent of mammal species. Mangroves provide breeding grounds and nurseries for numerous species of fish and shellfish and help trap sediments that might otherwise adversely affect seagrass beds and coral reefs, which are habitats for many more marine species. Forests provide more than 86 million green jobs and support the livelihoods of an estimated 880 million people worldwide. Forests supply water, mitigate climate, change and provide habitats for many pollinators, which are essential for sustainable food production. It is estimated that 75 percent of the world's leading food crops, representing 35 percent of global food production, benefit from animal pollination for fruit, vegetable or seed production[3].

1.13 Forest ecosystems conserve soil and stabilize flows and runoff which in turn prevents land degradation and desertification, and diminishes the risks of natural disasters such as droughts, floods, and landslides. In essence, forests are important since they help in maintaining and upgrading the environmental quality (Figure 1.2)

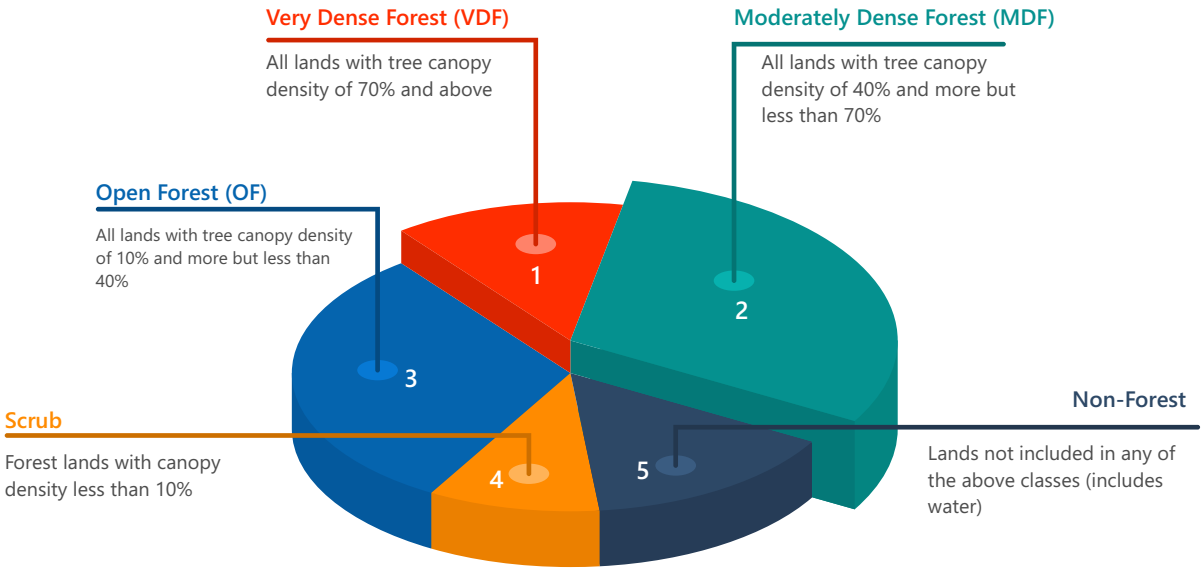
Figure 1.2: Ecosystem services provided by forests[4]

[3]The State of the World's Forests 2020: Forests, biodiversity and people
[4]Jenkins, M. and Schaap B., (2018), Forest Ecosystem Services, Background study prepared for the thirteenth session of the United Nations Forum on Forests, can be accessed at: https://www.un.org/esa/forests/wpcontent/uploads/2018/05/UNFF13_ BkgdStudy_ForestsEcoServices.pdf

1.14 Forests play a vital role in sustainable development, especially due to their role in providing livelihood to a significant portion of the population and hence in income generation. Nearly 25% (one fourth) of India's total land area is now under forest and tree cover. The evaluation of forest cover is undertaken by Forest Survey of India (FSI), Ministry of Environment, Forest & Climate Change (MoEF&CC), with a national assessment starting in the year 1987 using remote sensing techniques. The assessment is a biennial cycle at the National level which is published as the India State of Forest Report (ISFR). According to the India State of Forest Report 2023, the total forest cover of the country is 7,15,342.61 sq. km which is 21.76% of the geographical area of the country. The tree cover of the country is estimated as 1,12,014.34 sq. km which is 3.41% of the geographical area. Thus, the total forest and tree cover of the country is 8,27,356.95 sq. km which is 25.17% of the geographical area of the country.

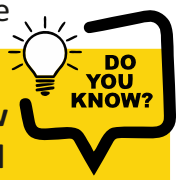
1.15 In India, forest cover has been classified by the Forest Survey of India in terms of the tree canopy. The description of different forest cover classes is given below in Figure 1.3:

Figure 1.3 Forest cover classes-



1.16 As per Champion and Seth (1968)[5] classification, India's forests are classified into four major groups, namely- tropical, sub-tropical, temperate and alpine. These four groups are further classified into 16 type groups (Table 1.1). The landscape of Indian forests ranges from Tropical Wet Evergreen Forests in the Andaman & Nicobar Islands, the Western Ghats, and the north-eastern States, to Dry Alpine Scrub high in the Himalayas in the north. The country has Semi-Evergreen Forests, Deciduous Forests, Thorn Forests, and Subtropical Pine Forests in the lower montane zone and Temperate Montane Forests in the higher zones. At the other extreme, tropical dry deciduous and thorn forests predominate in the semi-arid areas of Rajasthan and Gujarat.

1.17 The major classes are further divided into 16 type groups. The regional distribution of the forest type is given in the Table 1.1 below:



India is one of the few countries in the world to have a long-term forest cover increase trend, contrary to the global trend of deforestation.

Table 1.1: Regional Distribution of Forest Type as per Champion and Seth (1968) Classification-

S.no	*Forest Type Group*	*General Composition*	*Regional Occurrence (States of India)*
1	Tropical Wet Evergreen Forest (TWEF)	Dense tall forests, entirely evergreen or nearly so	NER excluding Meghalaya , Karnataka, Kerala, Tamil Nadu, Andaman & Nicobar Islands and Goa. Arunachal Pradesh, Assam, Nagaland
2	Tropical Semi-Evergreen Forests (TSEF)	Dominants includes deciduous species but evergreens predominant	Assam, Karnataka, Kerala, Maharashtra, Nagaland, Odisha, Tamil Nadu, Andaman & Nicobar Islands and Goa. Arunachal Pradesh, Bihar, Manipur, Meghalaya, Mizoram, Tripura, Uttar Pradesh, West Bengal
3	Tropical Moist Deciduous Forests (TMDF)	Dominants are mainly deciduous but sub-dominants and lower story largely evergreen top canopy even and dense but 25m high	Andhra Pradesh, NER excluding Arunachal Pradesh & Sikkim, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh, West Bengal, Andaman & Nicobar Islands, Goa , Himachal Pradesh, Assam, Chhattisgarh, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Telangana, Tripura, Uttarakhand, Dadar & Nagar Haveli and Daman & diu

[5]Champion, H. G. and Seth, S. K. (1968). A Revised Survey of Forest Types of India, Govt. of India Press, New Delhi, p. 404.

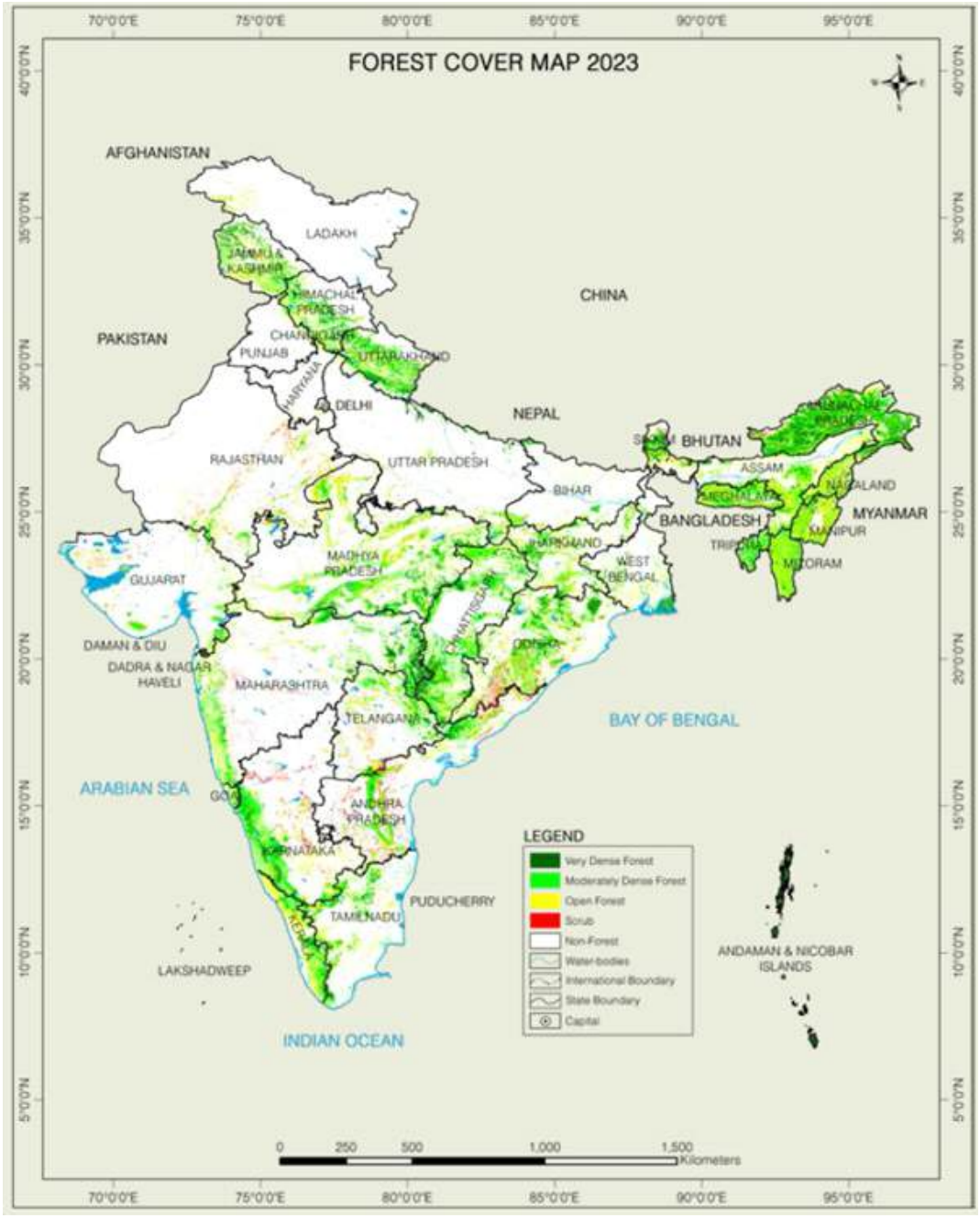
S.no	Forest Type Group	General Composition	Regional Occurrence (States of India)
3	Tropical Moist Deciduous Forests (TMDF)	Dominants are mainly deciduous but sub-dominants and lower story largely evergreen top canopy even and dense but 25m high	Andhra Pradesh, NER excluding Arunachal Pradesh & Sikkim, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh, West Bengal, Andaman & Nicobar Islands, Goa , Himachal Pradesh, Assam, Chhattisgarh, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Telangana, Tripura, Uttarakhand, Dadar & Nagar Haveli and Daman & diu
4	Littoral and Swamp Forests (L&SF)	Mainly evergreens of varying density and height but always associated predominantly with wetness	Andhra Pradesh, Gujarat, Maharashtra, Odisha, Tamil Nadu, West Bengal and Andaman & Nicobar Islands. Assam, Bihar, Goa, Karnataka, Kerala, Madhya Pradesh, Uttar Pradesh, Uttarakhand, Dadar & Nagar Haveli and Daman & diu, Puducherry
5	Tropical Dry Deciduous Forests (TDDF)	Entirely deciduous or nearly so top canopy uneven rarely over 25 m high	Andhra Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Jammu & Kashmir, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal, Chhattisgarh, Delhi, Goa, Jharkhand, Kerala, Telangana, Uttarakhand, Chandigarh, Dadar & Nagar Haveli and Daman & diu
6	Tropical Thorn Forests (TTF)	Deciduous with low thorny trees and xerophytes predominant top canopy more or less broken, less than 10 m high	Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh, Delhi, Kerala, Telangana, Dadar & Nagar Haveli and Daman & diu
7	Tropical Dry Evergreen Forests (TDEF)	Hard leaved evergreen trees predominate with some deciduous emergent often dense but usually under 20 m high	Andhra Pradesh and Tamil Nadu
8	Sub-Tropical Broad-Leaved Hill Forests (STBLHF)	Broad-leaved largely evergreen high forests	Assam and Meghalaya Arunachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, Sikkim, Tamil Nadu, West Bengal
9	Sub-Tropical Pine Forests (STPF)	Pine associated predominates	Arunachal Pradesh, Haryana, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Nagaland, Punjab, Assam, Mizoram, Uttarakhand

S.no	Forest Type Group	General Composition	Regional Occurrence (States of India)
10	Sub-Tropical Dry Evergreen Forests (STDEF)	Low xerophytic forest and scrubs	Jammu & Kashmir
11	Montane Wet Temperate Forests (MWTF)	Evergreen without coniferous species	Arunachal Pradesh, Manipur and Nagaland, Kerala, Sikkim, Tamil Nadu, West Bengal
12	Himalayan Moist Temperate Forest (HMTF)	Evergreen forests mainly sclerophyllous oak and coniferous species	Himachal Pradesh. Jammu & Kashmir, Arunachal Pradesh, Manipur, Nagaland, Sikkim, Uttarakhand, west Bengal, Ladakh
13	Himalayan Dry Temperate Forests (HDTF)	Coniferous forests with sparse xerophytic under-growth	Jammu & Kashmir and Himachal Pradesh Arunachal Pradesh, Uttarakhand, Ladakh
14	Sub-Alpine	Stunted deciduous or evergreen forests, usually close formation with or without conifers	Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Sikkim, Uttarakhand, West Bengal, Ladakh
15	Moist Alpine Scrub	Low but often dense scrub of evergreen species	Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Sikkim, Uttarakhand
16	Dry Alpine Scrub	Xerophytic scrub in open formation mostly of deciduous in nature	Arunachal Pradesh, Himachal Pradesh, Jammu & Kashmir, Uttarakhand, Ladakh

1.18 India is one of the few countries which have a National Forest Policy since 1894. The policy has been revised twice in 1952 and 1988 to account for the changing circumstances.

1.19 The forest cover in India is categorized into different types of Forests sources from the India State of Forest Report (ISFR), 2023 is presented in the Figure 1.4 below:

Figure 1.4 : India Forest Cover Map 2023



Source: India State of Forest Report - 2023, FSI, MoEFCC

Forest and SDGs

1.20 Forests are important since they help in maintaining and upgrading the environment quality which is beyond quantification. But with more and more fragmentation in the forests, there is deterioration in the quality of the services provided by the forests. Owing to the importance of the forestry sector, the agreement on the first-ever United Nations Strategic Plan for Forests[6] (2017-2030) was forged at a special session of the UN Forum on Forests in January 2017 and the Plan was adopted by the UN General Assembly on 27 April 2017. The Strategic Plan features a set of six Global Forest Goals and 26 associated targets to be archive by 2030, which are voluntary and universal.

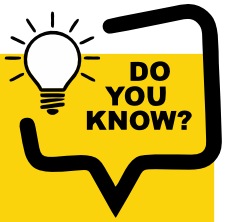
Figure 1.5 Global Forest Goal

1. • **Global Forest Goal 1:** Reverse the loss of forest cover worldwide through sustainable forest management, including protection, restoration, afforestation and reforestation, and increase efforts to prevent forest degradation and contribute to the global effort of addressing climate change.
2. • **Global Forest Goal 2:** Enhance forest-based economic, social and environmental benefits, including by improving the livelihoods of forest-dependent people.
3. • **Global Forest Goal 3:** Increase significantly the area of protected forests worldwide and other areas of sustainably managed forests, as well as the proportion of forest products from sustainably managed forests.
4. • **Global Forest Goal 4:** Mobilize significantly increased, new and additional financial resources from all sources for the implementation of sustainable forest management and strengthen scientific and technical cooperation and partnerships.
5. • **Global Forest Goal 5:** Promote governance frameworks to implement sustainable forest management, including through the UN Forest Instrument, and enhance the contribution of forests to the 2030 Agenda.
6. • **Global Forest Goal 6:** Enhance cooperation, coordination, coherence and synergies on forest-related issues at all levels, including within the UN System and across Collaborative Partnership on Forests member organizations, as well as across sectors and relevant stakeholders.

[6]United Nation Strategic Plan for Forest 2030-https://www.un.org/esa/forests/wp-content/uploads/2017/09/UNSPF-Briefing_Note.pdf

1.21 Forests presently cover 30 percent of the Earth's land area, or nearly 4 billion hectares. The Strategic Plan features targets to increase global forest area by 3% by 2030, signifying an increase of 120 million hectares, an area over twice the size of France and to eradicate extreme poverty for all forest-dependent people by 2030. Global Forests Goals and targets contribute to 2030 Agenda for Sustainable Development because forests and trees provide help to millions of people living in poverty by way of food, fuel for cooking and heating, water, medicine, shelter and clothing and function as safety nets in crises. The six Global Forest Goals and 26 associated targets support the objectives of the International Arrangement on Forests and aim to contribute to progress on the Sustainable Development Goals, the Rio conventions and other international forest related instruments, and processes. The vision statement of the UN Strategic Plan for Forests 2030 calls for a world where forests are "sustainably managed, contribute to sustainable development and provide economic, social, environmental and cultural benefits for present and future generations." When sustainably managed, forests are healthy, productive, resilient and renewable ecosystems which provide essential goods and services to people worldwide. An estimated 1.6 billion people – 25% of the global population – depend on forests for subsistence, livelihood, employment and income generation.

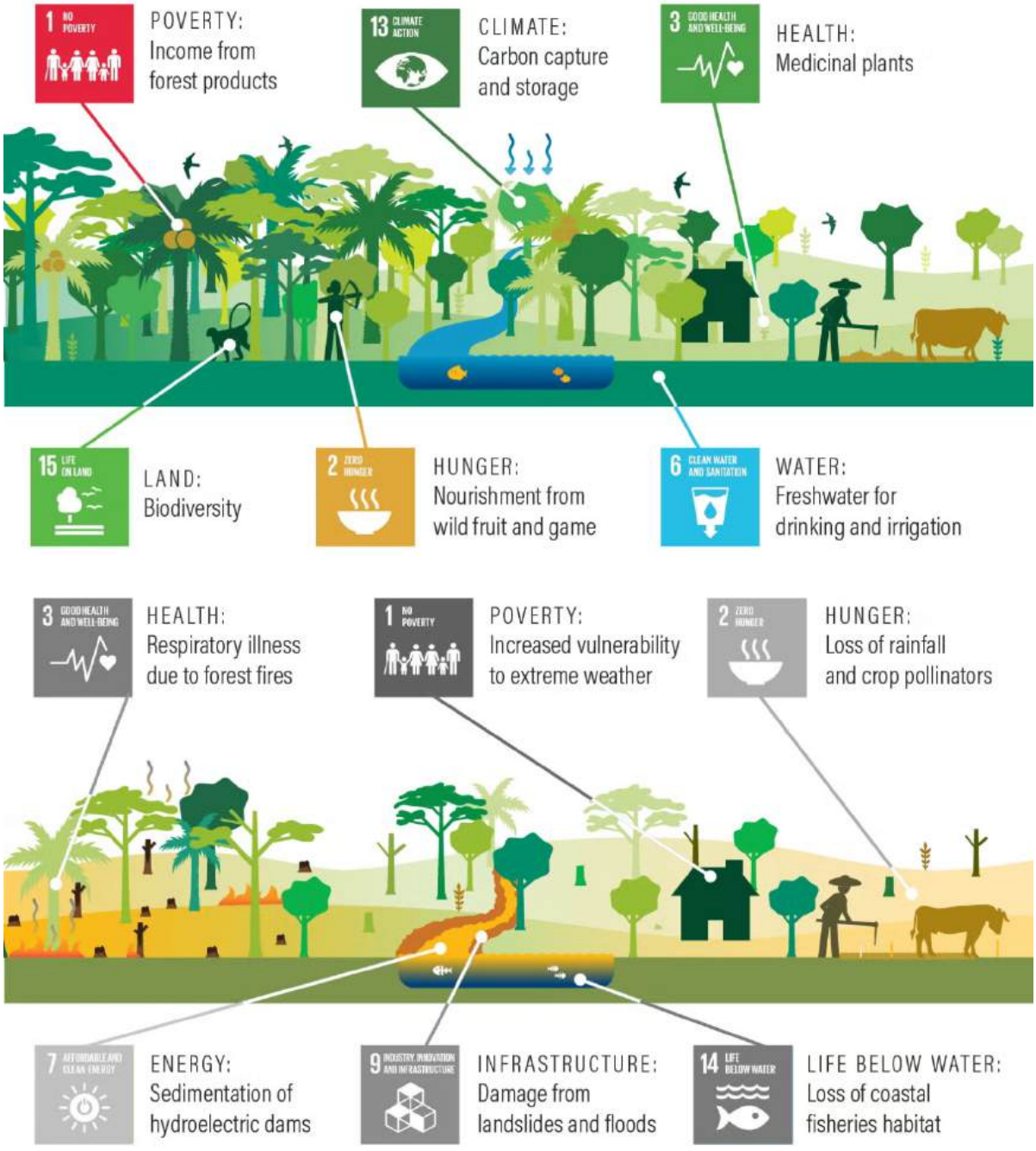
1.22 In the "2030 Agenda for Sustainable Development" adopted by 196 countries including India in 2015, which lists the Sustainable Development Goals (SDGs), 17 goals and 169 targets to be achieved over the next 15 years have been spelled out. Owing to the importance of forests, out of these global goals, 8 Goals are directly or indirectly related to forestry activities[7] (shown in Figure1.6).



India is home to 70% of the world's tiger population, with most tigers residing in forest ecosystems.

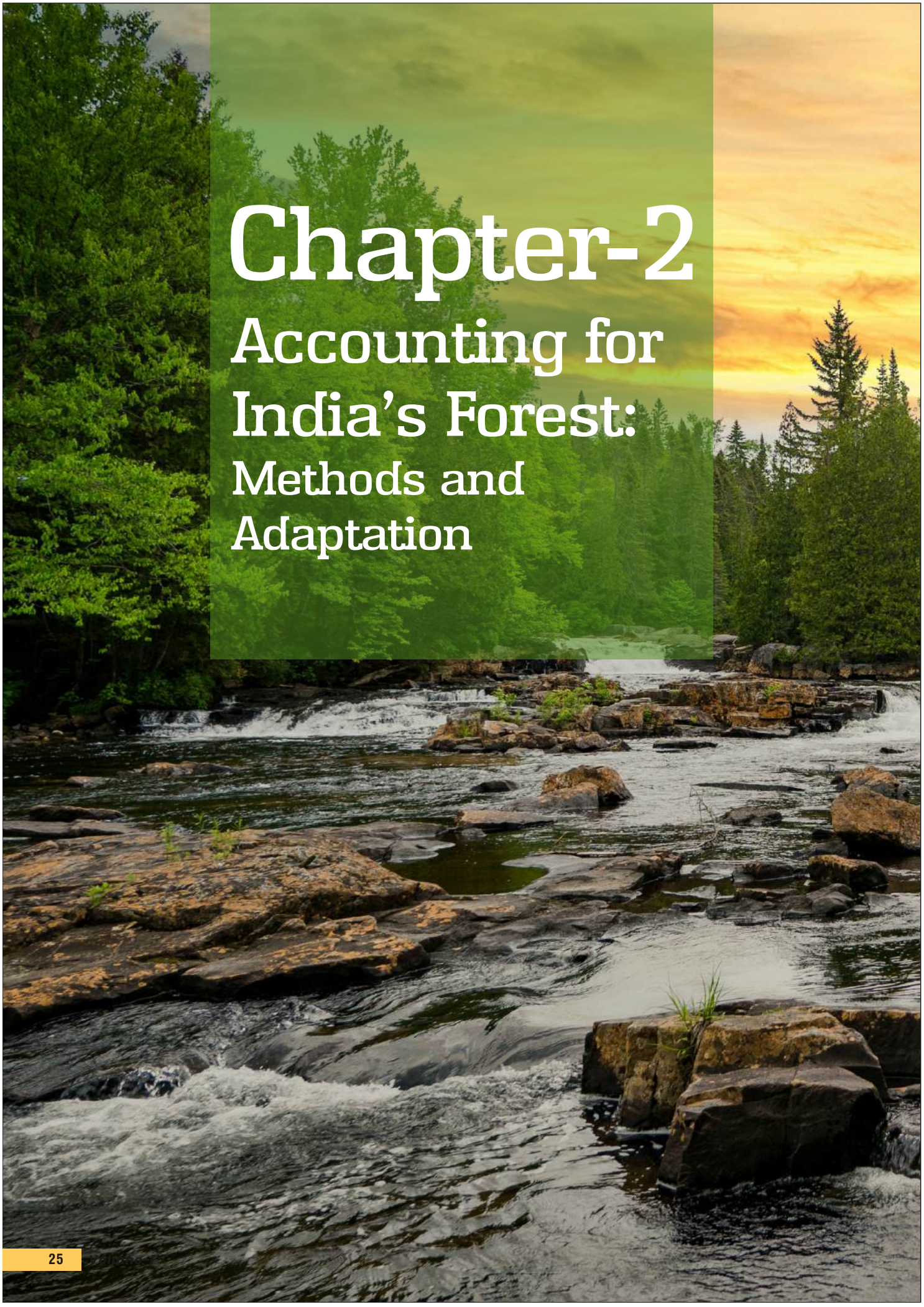
[7]https://www.fao.org/forestry/our-focus/working-towards-the-sustainable-development-goals/en?utm

Figure 1.6: Forest and SDGs[8]



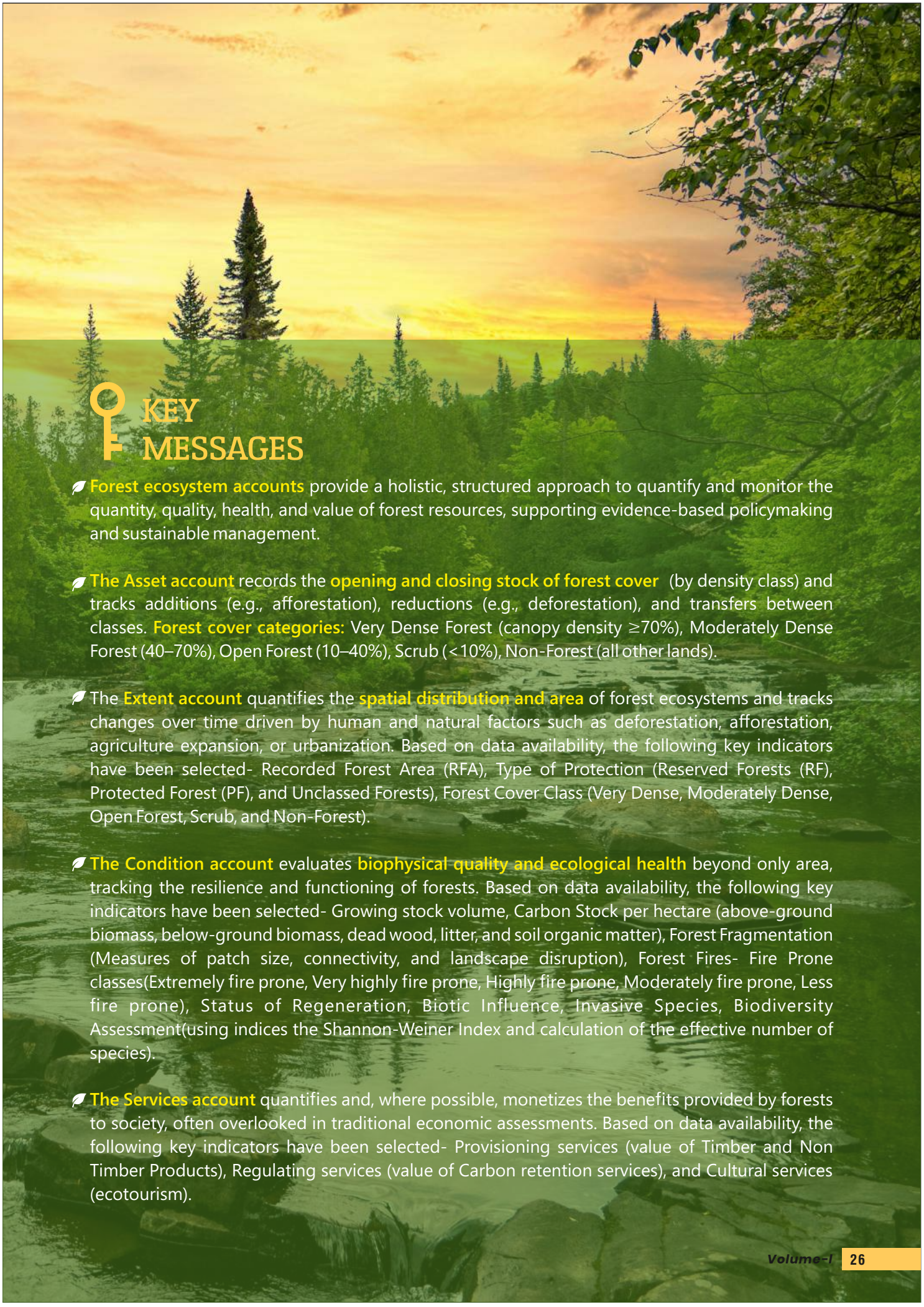
[8]https://www.wri.org/blog/2017/09/forests-and-sdgs-taking-second-look

1.23 Forests are linked to the other SDGs as well – forest-based ecosystem services play an underpinning role in sustainable agricultural production and food security. Forests regulate hydrological services including the quantity, quality, and timing of water available for irrigation. Forest-based bats and bees pollinate crops. Forests mitigate impacts of climate change and also extreme weather events at the landscape scale. In addition to offering resilience against severe weather events like floods, storms and cyclones, they also act as carbon sinks, absorbing huge quantities of CO2. Therefore preserving and restoring forests, is crucial for achieving global climate goals and ensuring the well-being of both human populations and ecosystems.



Chapter-2

Accounting for India's Forest: Methods and Adaptation



KEY MESSAGES

- **Forest ecosystem accounts** provide a holistic, structured approach to quantify and monitor the quantity, quality, health, and value of forest resources, supporting evidence-based policymaking and sustainable management.

- **The Asset account** records the **opening and closing stock of forest cover** (by density class) and tracks additions (e.g., afforestation), reductions (e.g., deforestation), and transfers between classes. **Forest cover categories:** Very Dense Forest (canopy density ≥70%), Moderately Dense Forest (40–70%), Open Forest (10–40%), Scrub (<10%), Non-Forest (all other lands).

- The **Extent account** quantifies the **spatial distribution and area** of forest ecosystems and tracks changes over time driven by human and natural factors such as deforestation, afforestation, agriculture expansion, or urbanization. Based on data availability, the following key indicators have been selected- Recorded Forest Area (RFA), Type of Protection (Reserved Forests (RF), Protected Forest (PF), and Unclassed Forests), Forest Cover Class (Very Dense, Moderately Dense, Open Forest, Scrub, and Non-Forest).

- **The Condition account** evaluates **biophysical quality and ecological health** beyond only area, tracking the resilience and functioning of forests. Based on data availability, the following key indicators have been selected- Growing stock volume, Carbon Stock per hectare (above-ground biomass, below-ground biomass, dead wood, litter, and soil organic matter), Forest Fragmentation (Measures of patch size, connectivity, and landscape disruption), Forest Fires- Fire Prone classes(Extremely fire prone, Very highly fire prone, Highly fire prone, Moderately fire prone, Less fire prone), Status of Regeneration, Biotic Influence, Invasive Species, Biodiversity Assessment(using indices the Shannon-Weiner Index and calculation of the effective number of species).

- **The Services account** quantifies and, where possible, monetizes the benefits provided by forests to society, often overlooked in traditional economic assessments. Based on data availability, the following key indicators have been selected- Provisioning services (value of Timber and Non Timber Products), Regulating services (value of Carbon retention services), and Cultural services (ecotourism).

Concept of Forest Accounts

This chapter outlines the methodological approaches adopted by MoSPI for forest ecosystem accounting in accordance with the System of Environmental-Economic Accounting Central Framework (SEEA CF)and SEEA Ecosystem Accounting (SEEA-EA) frameworks. It discusses the applicability/adaptation of various indicators discussed under SEEA-CF and SEEA-EA for Indian Forest Accounting and selecting the indicators most suitable for the Indian context, ensuring the framework's relevance and applicability at national and state level in the country. The chapter also details the evaluation of various methodological approaches for the extent account, condition account, and ecosystem services (such as timber provisioning services and non-timber forest product provisioning services, carbon retention regulating services, as well as cultural services which include eco-tourism) emphasizing a comprehensive and integrated assessment of India's diverse forest ecosystems.

2.1 Introduction: Forest accounting, as part of Environmental – Economic accounting, helps measure the Extent and Condition of forest ecosystems overtime, contributing to informed policymaking and sustainable management. The System of Environmental-Economic Accounting (SEEA) prescribes the framework for compilation of the extent and the condition accounts to understand the quality and the quantity of the forest with 'ecosystem condition' representing both quality and biophysical state measures that are required to understand the capacity of the ecosystem to generate various services which are useful to human being as well as economic well-being. Thus, SEEA helps to link the forest assets and the services provided by the forests with the economy.

2.2 Forest Asset Account: The intent of Asset account is to record the opening and closing stock of environmental asset and the different types of changes in the stock over an accounting period. Forest asset account is broadly considered the type of forest cover categorize into five density classes- Very Dense forest, moderately dense Forest, Open Forest, Scrub, and Non-Forest.

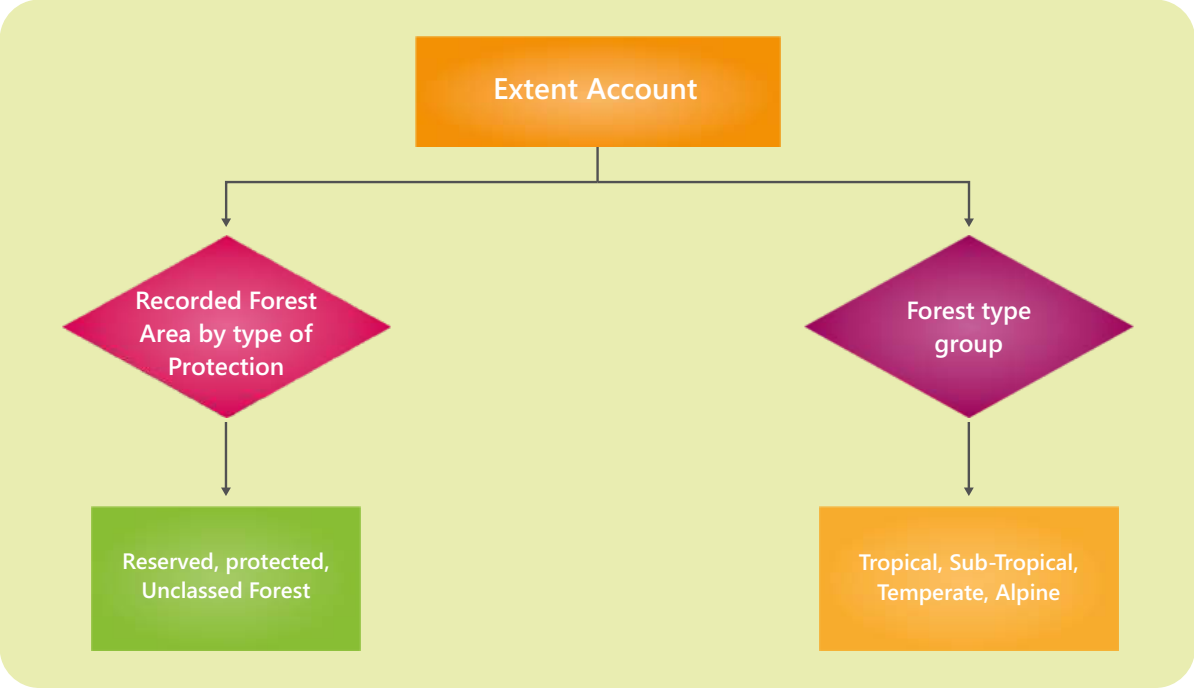
Figure 2.1 Forest asset account-

The Asset Account for Forests for the period 2010-11 to 2021-22 has been developed using data from the India State of Forest Report (ISFR) published by the Forest Survey of India (FSI). The asset account is made by taking the opening stock of forest cover (sq. km) for 2010-11 and subsequently adding the increments to stock (afforestation and natural expansion) for each assessment period (ISFR, 2013 to ISFR, 2023). Likewise, reductions in stock (deforestation and natural regression) are subtracted for each assessment period to determine the closing stock of forests in 2021-22. Notably, the closing stock for any given assessment period serves as the opening stock for the subsequent period. However, it is important to highlight that when a discrepancy was observed

between the opening stock and the closing stock recorded, adjustment was done accordingly. This variation was largely attributed to advancements in satellite data quality, particularly, improvements in radiometric resolution, increased intensity of ground-truthing, extensive use of higher-resolution collateral data, and additional information provided by State Forest Departments.

2.3 Extent account: The Extent account organizes information on the extent of different ecosystem assets within a country or other ecosystem accounting areas and how that extent changes over time. In terms of forests, the extent account supports the derivation of coherent indicators of deforestation, desertification, agricultural conversion, urbanisation and other forms of ecosystem change. Extent accounts also support the measurement of ecosystem diversity, fragmentation and the derivation of indicators of changes in biodiversity[9]. For the preparation of accounts, on the basis of data availability, we have covered following indicators-

Figure 2.2 Forest asset account-



[9]NCAVES Section 2

2.4 Recorded forest area by Type of Protection: Forest Land is broadly categorized into three main types based on Protection- Reserved Forest, Protected Forest and Unclassed Forest.

- Reserved Forest -An area so constituted under the provisions of the Indian Forest Act or other State Forest Acts, having full degree of protection. In Reserved forests all activities are prohibited unless permitted.

- Protected Forest -An area notified under the provisions of the Indian Forest Act or other State Forest Acts, having limited degree of protection. In protected forest all activities are permitted unless prohibited.

- Unclassed Forest -An area recorded as forest but not included in reserved or protected forest category. Ownership status of such forests varies from state to state.

The project "Natural Capital Accounting and Valuation of Ecosystem Services" (NCAVES) was launched in 2017 with an aim to advance both the knowledge agenda and the development of policy-applications of environmental-economic accounting, and in particular for ecosystem accounting. The project initiated pilot testing SEEA Ecosystem Accounting (SEEA EA) in five participating partner countries, namely Brazil, China, India, Mexico and South Africa.

2.5 Forest type Groups: This has already been comprehensively addressed in Chapter 1.

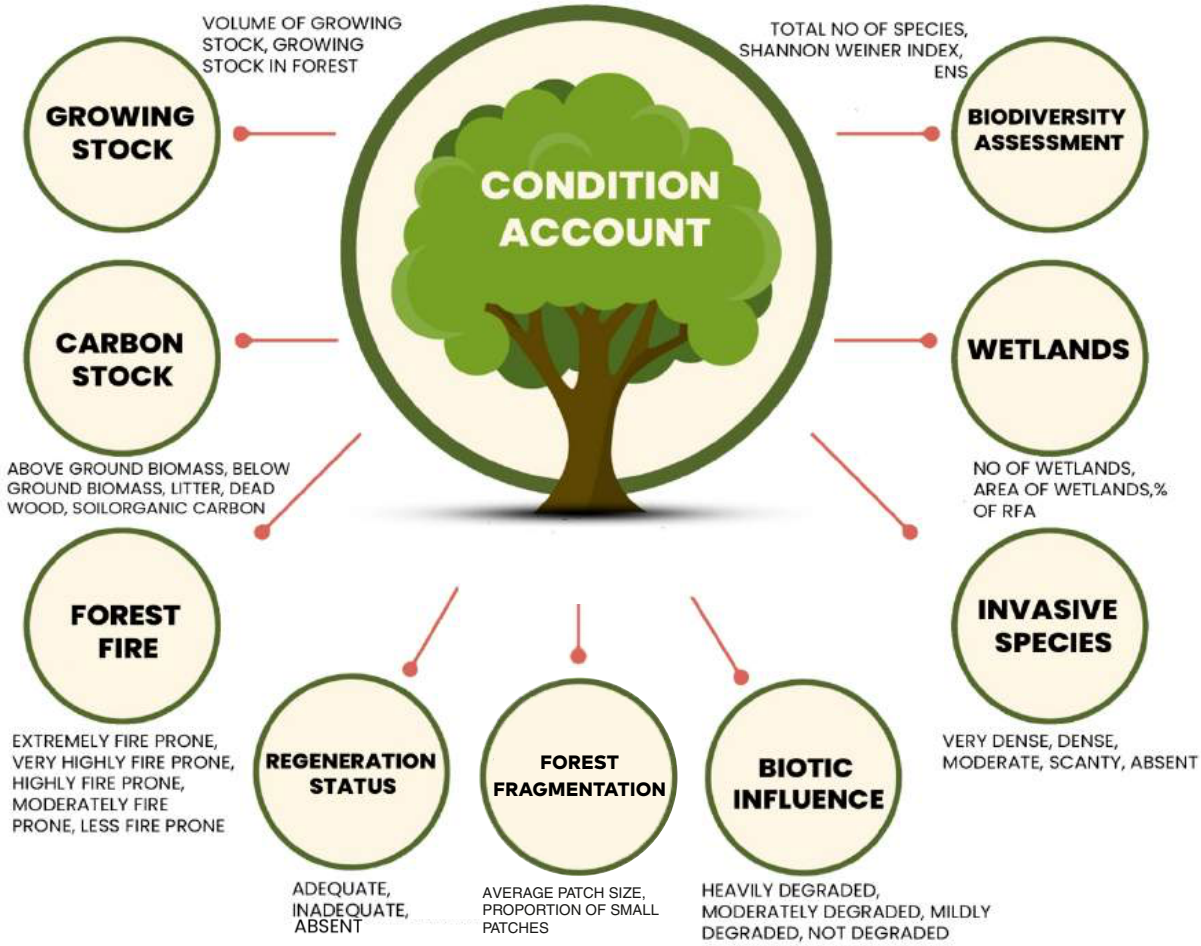
2.6 Condition Account: The ecosystem condition account provides insight about the characteristics and quality of ecosystem assets and how they have changed during the accounting period. Measurement of ecosystem condition is of significant interest when it comes to supporting environmental policy and decision-making that is commonly focused on protecting, maintaining and restoring ecosystem condition. In the context of our condition account, key indicators have been incorporated drawing from the report of Natural Capital Accounting and valuation of Ecosystem Services (NCAVES)[10]. These include the volume of growing stock, carbon stock, carbon stock per hectare, forest fragmentation, **the number and area of wetlands within the Recorded Forest Area (RFA), comprehensive biodiversity assessments, the total numbers of species of herbs, shrubs, and trees, the Shannon-Weiner Index and the effective number of species for herbs shrubs, and trees.**

[10]https://www.mospi.gov.in/natural-capital-accounting-valuation-ecosystem-services-ncaves

Furthermore, four indicators-namely, forest fire occurrence, status of regeneration, biotic influence, and the prevalence of invasive species-have been incorporated based on an extensive review of literature and in alignment with report of the United Nations' "System of Environmental-Economic Accounting- Ecosystem Accounting (SEEA EA)[11]" published in 2024 and indicator data availability.

Detailed format for condition account is given below -

Figure 2.3 Indicators under Condition account of Forest Ecosystems



[11] https://seea.un.org/ecosystem-accounting

2.7 Carbon Stock: The total carbon stocked in the forests is divided into five pools by Good Practice Guidance (GPG)[12] of the Intergovernmental Panel for Climate Change (IPCC). The living portion of biomass carbon is classified as 'above ground biomass (AGB)' and 'below ground biomass (BGB)' and stores significant amount of carbon. The 'dead organic matter (DOM)' is classified as 'dead wood' and 'litter'. The fifth pool is 'soil organic matter' which contains substantial amount of organic carbon. Description about the classification of different carbon pools is presented in table 2.1-

Table 2.1: Classification of carbon stock in forests under different carbon pools

Pools		***Description***
Living Biomass	Above ground biomass (AGB)	All living biomass above the soil including stem, stump, branches, bark, seeds and foliage.
	Below ground biomass (BGB)	All living biomass of live roots. Fine roots of less than 2mm diameter (country specific) are often excluded because these often cannot be distinguished empirically from soil organic matter or litter.
Dead Organic Matter	Dead wood	Includes all non-living woody biomass not contained in the litter, either standing or lying on the ground. Dead wood also includes dead roots and stumps larger than or equal to 10cm in diameter or any other diameter used by the country.
	Litter	Includes all non-living biomass with a diameter less than a minimum diameter chosen by the country (for FSI 5 cm), lying dead, in various states of decomposition above the mineral or organic soil.
Soil	Soil organic matter	Includes organic carbon in mineral and organic soils (including peat) to a specific depth chosen by the country (for FSI 30 cm) and applied consistently through the time series.

[12] (https://www.ipccnggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_1_Introduction.pdf)

2.8 Growing Stock: This is the volume of all living trees more than 10 cm in diameter at breast height (or above buttress if these are higher) measured over bark from ground or stump height to a top stem diameter of 10 cm, including branches to a minimum diameter of 5 cm. The term excludes smaller branches, twigs, foliage, flowers, seeds, stump and roots. The growing stock is generally estimated through the forest inventories, which are essentially a 'field data collection' exercise following a suitable and robust sampling design. Forest inventory gives both qualitative and quantitative information about the forests. Qualitative information includes legal status, land use, biotic influence, grazing incidence, etc., whereas the quantitative information includes species and stratum wise growing stock, diameter class distribution of growing stock, number of trees, regeneration status, etc.[13]

2.9 Forest Fragmentation[14]: Forest fragmentation is the breaking of a large, contiguous forested area into smaller parts of forests, which are mostly separated by roads, utility corridors, agriculture, other subdivisions, or human developments. With time, these patches that separate the different pieces of forest tend to multiply and expand, which affects the health, value and functioning of the forest and forest ecosystem and the ecosystems within forests. Fragmentation generally leads to loss of biodiversity, increases in invasive plants, pests, and pathogens, and a reduction in water quality.

- Average forest patch size is one of the indicators that can summarize the data on different patch sizes. The formula for calculating average forest patch size is given below:

$$Average\ forest\ patch\ size = \frac{Total\ forest area}{Total\ no\ of\ forest\ Patches}$$

- Similarly, the proportion of small forest patches is also a relevant indicator summarizing the data of forest fragmentation. It will indicate the relative number of patches in the category of patch size greater than equal to 0.01 km^2 and less than equal to 1 km^2 in comparison to the total number of patches.

[13]India State of Forest Report 2023 (Volume-I)
[14]The term and definition of "forest fragmentation" are sourced from NCAVES. https://www.mospi.gov.in/natural-capital-accounting-valuation-ecosystem-services-ncaves

$$\text{Proportion of small patches } (\geq 0.01km^2 \text{ to } \leq 1km^2)[\%] = \left(\frac{\text{Number of patches in Patch size range of } \geq 0.01km^2 \text{ to } \leq 1\ km^2}{\text{Total number of forest patches}} \right) * 100$$

Note- Seven patch size ranges were reported in the 2013 assessment, while eight were reported in 2017. The first two ranges in 2017 do not match those from 2013. To ensure consistency between the assessments, the 2013 data for the ≥0.976≤1 range was included under the ≥0.01≤1 category to align with the 2017 patch size ranges.

2.10 Forest fire: Forest fires have been an integral part of forest ecosystems, playing a pivotal role in shaping their conservation and management. Despite their benefits in terms of facilitating regeneration and clearing forest floors, the losses associated with fires far outweigh these benefits. The main parameters to assess the loss due to forest fire consist of timber loss, carbon loss, loss of NWFP, loss of micro flora & fauna, loss of habitat, people's dependency on forest resources, etc. The majority of fires, intentional or accidental, are caused by human activities. While India mainly experiences surface fires confined to the forest floor, their intensity and frequency fluctuate due to factors like dry fuel accumulation, prolonged droughts, and local influences.

Currently, Forest Survey of India (FSI) has been alerting State Forest Departments about forest fire incidences detected by the MODIS (Moderate Resolution Imaging Spectro-radiometer) sensor on-board Aqua and Terra Satellites of NASA and based on SNPP-VIIRS sensor. Forest fire area is mainly categorised into Five types-**Extremely fire prone, Very Highly fire prone, Highly fire prone, Moderately fire prone, Less fire prone.**[15]

2.11 Status of regeneration: Intensity of regeneration refers to the extent the regeneration is established in an area for a given species or a group of species. The process of replacing old crop with the younger generation, either naturally or artificially, is called regeneration or reproduction. Forest regeneration processes also include interventions like assisted natural regeneration, seed origin, enrichment planting, controls to reduce grazing and lopping activities, etc. For recording status of regeneration, data from 1.7 m radius circular plots was recorded from within all four sub plots at a distance of 5 m from its centre towards east. For calculating established (tree) plant units, established,

[15]India State of Forest Report 2023 (Volume-I)

un-established and recruits are given weight age as 1, 1/2 and 1/4 respectively. The sample plots which have 9 or more established (tree) plant units (in 36 m^2) are termed as having 'adequate' regeneration. If the established plant units are less than 9 but are equal or more than 0.5 then the sample point is termed as having 'inadequate' regeneration. If it is less than 0.5 then regeneration is considered 'absent'.[15]

2.12 Biotic Influence: Usually in forests, the biotic influences could include grazing, browsing, human-made fire, pollarding, illicit felling, and lopping. Biotic influence can be characterized as over population of herbivores, invasive species, pathogens, grazing, fire, pollarding, illicit felling, lopping, etc., in a nutshell. The biotic influence is observed on land surface of 60 m radius area around the plot centre .

- Heavily degraded- More than 50% area/crop affected
- Moderately degraded- 10-50% area affected
- Mildly degraded- Less than 10% area affected
- Not degraded- No biotic influence seen.

2.13 Invasive Species: Invasive Species, as defined by FAO, are those species that are non-indigenous to a particular ecosystem and whose introduction and spread causes, or is likely to cause socio-cultural, economic or environmental harm (including affecting the forest ecosystems) or harm to human health. Such species are non-native organisms that not only establish themselves in an area but also spread rapidly, often outcompeting or disrupting native species, thereby altering the ecosystem structure, disrupting succession and aid in spreading diseases within forest areas. For identification of invasive species, a separate album of 45 major invasive species has been prepared by FSI. The invasive species influence is observed on land surface of 60 m radius area around the plot centre.[15]

2.14 Wetlands: Wetlands are areas of land that are either seasonally or permanently covered by water, or nearly saturated by water. This means that a wetland is neither truly aquatic nor terrestrial; although in some cases, wetlands can switch between being aquatic or terrestrial for periods of time depending on seasonal variability. Thus, wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant plants and soil or sediment characteristics.[15]

[15]India State of Forest Report 2023 (Volume-I)

2.15 Biodiversity Assessment: Biodiversity within a forest is an essential indicator of forest ecosystem condition as it provides an indicator to represent the state of conservation of forest ecosystems and it can help to evaluate and monitor sustainability of the biological resources as well as be of high assistance in comparative evaluation of stability, productivity and ecosystem functions of forests.

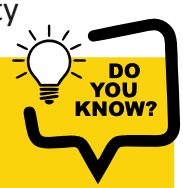
2.16 The Shannon-Weiner Index of Biodiversity is a commonly used indicator for comparing diversity between various habitats. It quantifies diversity of the species by measuring both species abundance and species richness. Shannon-Wiener index is Calculated by the following formula: -

$$H' = -\Sigma p_i \ln p_i$$

Where, p_i is the proportion of individuals found in species 'i'
For a well-sampled community, this proportion can be estimated as-

$$p_i = n_i / N,$$

where n_i is the number of individuals or the population of species i and N is the total number of individuals or total population across species in the community
By definition, pi will all be between zero and one, the natural log makes all the terms of the summation negative, which is why the inverse of the sum is taken. The Shannon-Wiener Index assumes that all species are represented in a sample and that they are randomly sampled. A high value of H' would be a representative of a diverse and equally distributed community, and lower values represent a less diverse community.
A community with only one species would have an H' value of 0 because p_i would equal 1 and be multiplied by In p_i which would equal zero. Values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4.



Over 45,000 plant species and nearly 91,000 animal species have been recorded in India, most of them forest-dependent.

The Shannon index increases as both the richness and the evenness of the community increase. That is, the more equal the proportions for each of the groups, the more homogeneous or even, they are. From the resultant Shannon index value, an effective number of species (ENS) can be subsequently computed using the following formula[16]:

$$Ens=exp(H')$$

Where H' is the Shannon Weiner Index.

2.17 Note-In India, the Forest Survey of India (FSI) is mandated with the Forest Resource Assessment, which it undertakes on a biennial basis. The report of the assessment is published as the India State of Forest Report. Data and definition for all the indicators explained above have been sourced from the India State of Forest Report. However, it is to mentioned that data for Shannon Wiener Index is available at state/UT level only.

[16]8 Aguilar J, Gramig GG, Hendrickson JR, Archer DW, Forcella F, Liebig MA (2015) Crop Species Diversity Changes in the United States: 1978–2012. PLoS ONE 10(8): e0136580. doi:10.1371/journal.pone.0136580

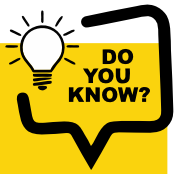
Forest Ecosystem Services

2.18 The forest ecosystems provide critical and diverse values and services to human society. As primary habitats for a wide range of species, forests support biodiversity maintenance and conservation. Forest growth sequesters and stores carbon from the atmosphere, contributing to the regulation of the global carbon cycle and climate change mitigation. Healthy forest ecosystems produce and conserve soil and stabilize stream flows and water runoff—preventing land degradation and desertification, and reducing the risks of natural disasters such as droughts, floods, and landslides. Forests also serve as sites of aesthetic, recreational, and spiritual value in many cultural and societal contexts, and contribute to poverty eradication and economic development by providing food, fibre, timber, and other forest products for subsistence and income generation.

2.19 In this chapter, methodology for valuation of four ecosystem services from forests have been presented:

- Timber Provisioning Services
- Non-Timber Provisioning Services
- Carbon Retention Services
- Cultural Service (Ecotourism)

There are still several other indicators of condition and ecosystem services provided by forests that have not been included in this assessment, but are nevertheless, very important.



Western Ghats, a UNESCO World Heritage Site, is one of the eight "hottest hotspots" of biodiversity globally.

Timber and Non-timber Forest Products (NTPF) Provisioning Services

2.20 The Forests Products are broadly classified into two categories- Timber and Non-timber Forest Products.

A) Timber includes rose wood, teak wood, jungle wood etc. The source of production of timber is either from forests or from trees outside forests (TOF). FAO[17] has defined TOF as "Trees on land not defined as forests and other wooded lands". In India, FSI has defined TOF as "all trees growing outside government Recorded Forest Areas (RFAs)" irrespective of patch size. Besides constituting a major source for the production of Industrial wood in India, its benefits are multidimensional.

B) Non-Timber Forest Products (NTFP) refers to all biological materials other than timber which are extracted from the forests for human use. NTFPs include plants used for food, beverages, forage, fuel, medicine, fibers and biochemicals; animals, birds and fish for food, fur and feathers; as well as their products such as honey, lac and silk. As per FAO, there are at least 150 NTFPs that contribute substantially to international trade, including honey, gum arabic, rattan and bamboo shoots, cork, forest nuts and mushrooms, oleoresins, essential oils, and plant or animal parts for pharmaceutical products.

2.21 In India, NTFPs are associated with the socio-economic and cultural life of forest dependent communities inhabiting a wide variety of ecological and geo-climatic conditions throughout the country. As per the census 2011, In India, the rural population is about 68% of the country's total Population and there are about 6,50,000 villages in the country, out of which nearly 1,70,000 villages are located in the proximity of forest areas, and so, often termed as Forest Fringe Villages (FFVs). Populations residing in these Forest Fringe Villages are dependent on the forests for meeting the needs of fuelwood, fodder, small timber, bamboo and NTFPs extraction has a multiplier effect in the economy by generating employment not only for the inhabitants of these Forest Fringe Villages, but also for others involved in downstream processing and trading activities.

Data and Methodology

Monetary Value of Timber and Non-timber Forest Products (NTFP) Provisioning Services

[17]https://www.fao.org/3/cb9360en/online/cb9360en.html

Table 2.2 The methodology of estimation of the value of Timber and NTFP provisioning services is as follows:

Step	Item	Method of estimation (at current prices)
1	Value of output of Industrial wood and Non-Timber Forest Products	Estimates are taken from the National Accounts
2	$\frac{Forest\ Rent}{GVO\ of\ Forestry}$	Estimated using the following factors: $\frac{Forest\ Rent}{GDP} * \frac{GDP}{GVA\ of\ Forestry} * \frac{GVA\ of\ Forestry}{GVO\ of\ Forestry}$
3	Value of Timber and NTFP provisioning service	Value of Service = $\frac{Forest\ Rent}{GVO\ of\ Forestry} * Value\ of\ Output\ of\ Timber\ and\ NTFP$

2.22 Each of the items mentioned above are discussed as follows:

In the National Accounts, the Gross Value Added (GVA) from the Forestry sector is compiled in three groups:
(i) **Industrial Wood** (timber, round wood, match and pulpwood)
(ii) **Fuel wood** (firewood and charcoal wood), and
(iii) **Non-Timber Forest Products** (NTFPs) comprising a large number of wild-growing forest material such as bamboo, fodder, lac, sandalwood, honey, resin, gum, tendu leaves (Diospyros Melanoxylon), cork, balsams, eelgrass, acorns, horse chestnuts, mosses, lichens etc. The estimation of Gross Value Added from the "Forestry and Logging" sector in India is carried out by the production approach. It aims at estimating the value of output at factor cost in the first instance and then deducting the value of various inputs at purchaser's prices. The state wise estimated of value of timber provisioning service are based on these exchange values that are adopted in compilation of National Accounts Statistics.[18]

[18]State-wise and item-wise value of output from agriculture, forestry and fishing with Base Year: 2011-2012, MoSPI

Value of output of Industrial wood: The estimates are taken from National Accounts. (State-wise and Item-wise Value of Output from agriculture, Forestry and Fishing).

The data on production and prices of industrial wood/timber are supplied by State Forest Departments (SFDs). Estimates of value of output at current prices are compiled by multiplying the category-wise production figures with their respective average annual prices, both of which are supplied by the SFDs. In addition to the production of industrial wood from these Government forests, there would be-
(i) Authorized (but unrecorded) removals of timber from forests; and
(ii) Unrecorded production of industrial wood from private owned forests and non-traditional forest areas (e.g. trees in village common fields, ridges, canal sides, road sides, fruit trees no longer productive etc.).

The value of unrecorded, but authorized, production from forests is taken as 10% of the value of recorded production. The estimates of industrial wood from trees outside forests (TOF) (i.e. private owned forests and non-traditional forest areas like village commons, field ridges, canal sides, road sides, fruit trees no longer productive etc.) are provided by the Forest Survey of India on the request of SFD through a special study in collaboration mode with SFD. Prices for the same are also provided by the SFDs.

Value of output of Non-Timber Forest Products: The estimates are taken from National Accounts. (State-wise and Item-wise Value of Output from agriculture, Forestry and Fishing)

Valuations of NTFP Provisioning Services are also based on the concept of exchange value. The state-wise estimates of the value of output of non-timber forest products, and separate estimates of fuel wood are available in India's National Accounts Statistics.[19] The items of NTFP vary from state to state. Information is built up on the basis of royalty received (in value terms) from those authorized to extract these from the forests. Value of Fodder from forest, as estimated using the 'per animal consumption' norms, is also a component of the estimate of NTFPs, as available in the National Accounts Statistics.

[19]State-wise and Item-wise Value of Output from Agriculture, Forestry and Fishing, National Accounts Division, NSO, MoSPI

GVA and GVO of Forestry: The estimates are taken from National Accounts. (State-wise and Item-wise Value of Output from agriculture, Forestry and Fishing)

Forest Rent: Forest Rent as a percentage of GDP is taken from the **World Bank's database.**[20] (https://data.worldbank.org/indicator/NY.GDP.FRST.RT.ZS)

According to the Metadata Glossary of the World Bank, Forest rents[21] are roundwood harvest times the product of regional prices and a regional rental rate. Forest rent as a percentage of the gross value of output of Timber/NTFP can then be estimated using GVO-Forestry, GVA-Forestry and GDP. This value can be said to approximate the share of 'rent' and thus can be used to estimate the value of timber and NTFP provisioning services. The estimate of forest rent per GDP for India and other countries is **available till 2021-22.**

[19]State-wise and Item-wise Value of Output from Agriculture, Forestry and Fishing, National Accounts Division, NSO, MoSPI
[20]https://databank.worldbank.org/home.aspx; Forest Rents to GDP for India, as downloaded on September 17, 2020
[21]https://databank.worldbank.org/metadataglossary/world-development-indicators/series/NY.GDP.FRST.RT.ZS

Carbon Retention Service

2.23 Forests play a key role within the global carbon cycle and adaptation to climate change, removing carbon dioxide (CO_2) from the atmosphere and converting it to wood as they grow, and releasing carbon dioxide back into the atmosphere when trees are burned or decay. The forest and land-use sector are thus unique in that it can act as either a source or a sink for carbon, with the potential to sequester carbon and thus reduce net CO_2 emissions. If not for forests, much of this carbon would remain in the atmosphere in the form of carbon dioxide (CO_2), the most important greenhouse gas driving climate change. The diversity of forests in India makes it resilient to climate change and an efficient sink of carbon.

2.24 India is committed at the highest level to meet its commitments under the Nationally Determined Contributions (NDC) made to the international community under the Paris Agreement (2015). As one of the three NDCs, India has committed to create additional carbon sink of 2.5 to 3.0 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030.

2.25 Apart from potential carbon that could sequester in forests, the existing carbon stored in forests has an economic value too as the forests lock up the carbon from getting released into the atmosphere and avoid escalation of the climate change concerns. The social cost of carbon (SCC) represents the economic cost associated with climate damage (or benefit) resulting from the emission of an additional ton of Co_2.[22] Hence the social cost of carbon is often used as a carbon price estimate.

2.26 The Social Cost of Carbon (SCC) represents the economic cost associated with climate damage (or benefit) resulting from the emission of an additional ton of Co_2.[23] Hence the social cost of carbon is often used as a carbon price estimate. India's country level social cost of a tonne of Co_2 is US$ 86 as per the Nature Climate Change article for the year 2017-18. India's country-level social cost of a tonne of Co_2 for other years can be estimated using the GDP deflator.

[22]Ricke, K., Drouet, L., Caldeira, K., &Tavoni, M. (2018). Country-level social cost of carbon. Nature Climate Change, 8(10), 895-900.
[23]Ricke, K., Drouet, L., Caldeira, K., &Tavoni, M. (2018). Country-level social cost of carbon. Nature Climate Change, 8(10), 895-900 https://www.nature.com/articles/s41558-018-0282-y.epdf?author_access_token=XLBRLEGdT_Kv0n8_Onvped RgN0jAjWel9jnR3ZoTv0Ms70oz073vBeHQkQJXsJbey6vjdAHHSPxkHEN8nflPeQI6U86-MxWO1T1uUiSvN2A-srp5G9s7Yw GWt6-cuKn2e83mvZEpXG3r-J0nv0gYuA%3D%3D

2.27 With a view to understand the carbon retention services provided by the forests of India which also contribute to the global climate regulation, estimates for economic value of carbon retention are compiled using Social Cost of Carbon (SCC) approach. To ensure consistency with national accounts, exchange rate data, and the Social Cost of Carbon (SCC), the period used for calculating carbon retention services is aligned with the forest cover mapping period reported in the respective ISFR. For example, when estimating carbon retention services using ISFR 2017, the estimate corresponds to the year 2015–16, during which the forest cover mapping was conducted. Furthermore, since carbon stock values at the national and state levels are available from ISFR 2017 onwards, estimates at constant prices have been compiled starting from the year 2015–16 for subsequent ISFR years.The base year for constant prices has been considered as 2011-12, keeping the estimates consistent with National Accounts.

Table 2.3 Step wise methodologies used for valuation of carbon retention service is as follows:

Steps	*Method of Estimation*	*Data Sources/Assumptions*
1	Total Carbon Stock = Above ground biomass + Below ground biomass + Dead wood + Litter + Soil Organic Carbon	India State of Forest Report, Forest Survey of India
2	Carbon stock (CO_2 eq.) = Carbon stock * 3.67	Based on IPCC conventions[24]
3	Value of carbon stock (CO_2 eq.) in US$ = Carbon dioxide * Social Cost of tonne of CO_2	Using India's country-level social cost of a tonne of CO_2 (CSCC) emission as mentioned in Ricke et al article which is US$ 86 for the year 2017-18. For the other years, CSCC has been estimated using the GDP deflator rate.
4	Value of carbon stock (CO_2 eq.) in INR = Value of carbon stock in US$ * Exchange rate	Using the exchange rate of Indian Rupee vis-à-vis the US Dollar (in Financial Year-Annual Average)[25]. For estimating at constant prices, exchange rate for the year 2011-12 has been used. (source: RBI)
5	Value of Carbon Retention Service = Value of carbon stock (CO_2 eq.) (as obtained in step 4) * Rate of return	A 3% rate of return has been assumed, which is equivalent to the discount rate taken for calculating CSCC[26].

[24]Penman, J., M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, et al. 2003. Good practice guidance for land use, land-use change and forestry. Institute for Global Environmental Strategies, Hayama, Japan

[25]Handbook of Statistics on Indian Economy, Reserve Bank of India available at https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20Economy

[26]Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide (2017): https://www.nap.edu/read/24651/chapter/9

Cultural Service (Ecotourism)

2.28 The Ministry of Environment, Forest and Climate Change describes Ecotourism as **'responsible travel to natural areas that conserves the environment and improves the well-being of local people'**. Such tourism is low-impact, educational, and conserves the environment while directly benefiting the economic development of local communities. According to the UNWTO, ecotourism refers to forms of tourism which have the following characteristics:

1. All nature-based forms of tourism in which the main motivation of the tourists is the conservation and appreciation of nature as well as the traditional cultures prevailing in natural areas.
2. It contains educational and interpretation features.
3. It is generally, but not exclusively, organised by specialised tour operators for small groups. Service provider partners at the destinations tend to be small locally owned businesses
4. It minimises negative impacts upon the natural and sociocultural environment.
5. It supports the maintenance of natural areas which are used as ecotourism attractions by-

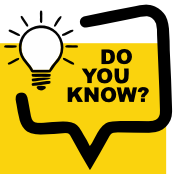
- Generating economic benefits for host communities, organisations and authorities managing natural areas with conservation purposes;
- Providing alternative employment and income opportunities for local communities;
- Increasing awareness towards the conservation of natural and cultural assets, both among locals and tourists

India's rich natural and Eco-tourism resources India has a significant geographical advantage owing to its rich natural & Eco-tourism resources- (a) 70 percent of the Himalayas, (b) 7,000 km of coastline, (c) Among the one of the three countries in the world with both hot and cold deserts, (d) Ranks 10th in total area under forest cover, (e) Ranks 6th in terms of the number of recognized UNESCO Natural Heritage sites. Ecotourism is now globally recognised as a powerful tool for the conservation of forests, biodiversity/ wildlife and scenic landscapes.

It does so by creating sustainable alternative livelihoods for forest-dependent communities and by generating conservation awareness among the masses and decision-makers. In order to strengthen community control and management of the forests, it is important to generate a sustainable flow of non-extractive financial benefits of forests for the communities, to ensure that the communities take interest in the conservation of forests and wildlife. Ecotourism is perhaps the only means of achieving this end. Apart from its conservation and economic value, public interest in nature-based recreation, i.e. Ecotourism is fast increasing. Ecotourism is one of the fastest-growing segments of the travel and tourism industry, which is one of the highest producers of global wealth and employment.

Ecotourism guidelines by MoFECC - In order to regulate and encourage planned development of areas in and around protected areas, the Ministry of Forest, Environment and Climate Change has recently notified "Ecotourism guidelines in and around protected areas 2021". These guidelines are based on the key recommendations of the Tiger Task Force (2005), provisions contained in the Wildlife (Protection) Act 1972, Scheduled Tribes and Other Forest Dwellers (Recognition of Forest Rights) Act 2006.

National Strategy for Ecotourism- In order to provide impetus to the development of Ecotourism and adventure tourism in the Country, the National Strategy for Ecotourism has been prepared. The National Strategy for Ecotourism takes into account the Ecotourism guidelines of MoEFCC, the National Strategy for Rural Tourism, and Sustainable Tourism. It identifies ecotourism as a key tool for forest, wildlife, and landscape conservation. It seeks to balance promotion of eco-friendly tourism with safeguarding ecological integrity and local culture, emphasizing capacity building and sustainable livelihoods for forest-dwelling communities.



India has declared 52 Tiger Reserves, 18 Biosphere Reserves, and over 100 National Parks, most of which are forest-based protected areas.

As part of integrating ecotourism under ecosystem services in the forest account, data on tourist inflow and ecotourism revenue from the forest for selected States and Union Territories for the years 2011-12 and 2019-20 have been sourced from Forestry Statistics 2021 by ICFRE.

2.29 Example Guide for Step-by-Step Valuation of Ecosystem Services

The figure provides a systematic approach for the assessment and valuation of forest ecosystem services, integrating both biophysical and economic perspectives. The process begins by clearly defining the assessment area, mapping the boundaries of the forest and determining the spatial extent for analysis using tools such as GIS or local resource mapping. Once the area is set, the next step involves identifying all beneficiaries and service-specific units, such as households, jobs, livestock, visitors, carbon pools, and water users, to ensure that all relevant stakeholders and ecosystem service flows are captured, for which data collection is carried out to capture each service of the forest ecosystem services based on determination of the valuation method.

The assessment then branches into two parallel pathways: physical quantification and monetary valuation. For physical units, the framework distinguishes between flow provisioning services (such as annual or seasonal harvests of timber or non-timber products), stock provisioning services (such as the standing biomass or carbon stock), and regulating and cultural services (such as recreational use, carbon sequestration, water purification, or biodiversity protection). For each, the relevant physical quantities are measured and recorded. The monetary valuation pathway transforms these physical measurements into economic values. Flow provisioning services are valued using local market prices, productivity methods, or wage rates. Stock provisioning services are valued based on prevailing market prices for timber or carbon, sometimes utilizing the social cost of carbon for climate regulation. Regulating and cultural services, which often lack direct market values, are
assessed using non-market valuation techniques such as the social cost of carbon, avoided cost, replacement cost, travel cost methods, contingent valuation, and choice experiments. These approaches may involve designing surveys or models to estimate public willingness to pay or accept compensation for ecosystem changes.

After monetary values are calculated, they are aggregated first at the data collection unit (DCU) level and then summed across the entire site or landscape to provide total values. The final step involves integrating and presenting results, which includes the use of multi-criteria decision analysis and benefit-transfer approaches to ensure the results are robust, transferable, and useful for policy, management, and reporting

Step-by-step breakdown:

Define Assessment Area

- Map Forest environmental service boundaries.
- Delineate spatial extent for analysis (e.g., village, management unit) using GIS or resource mapping

Selection of Valuation method for each service:

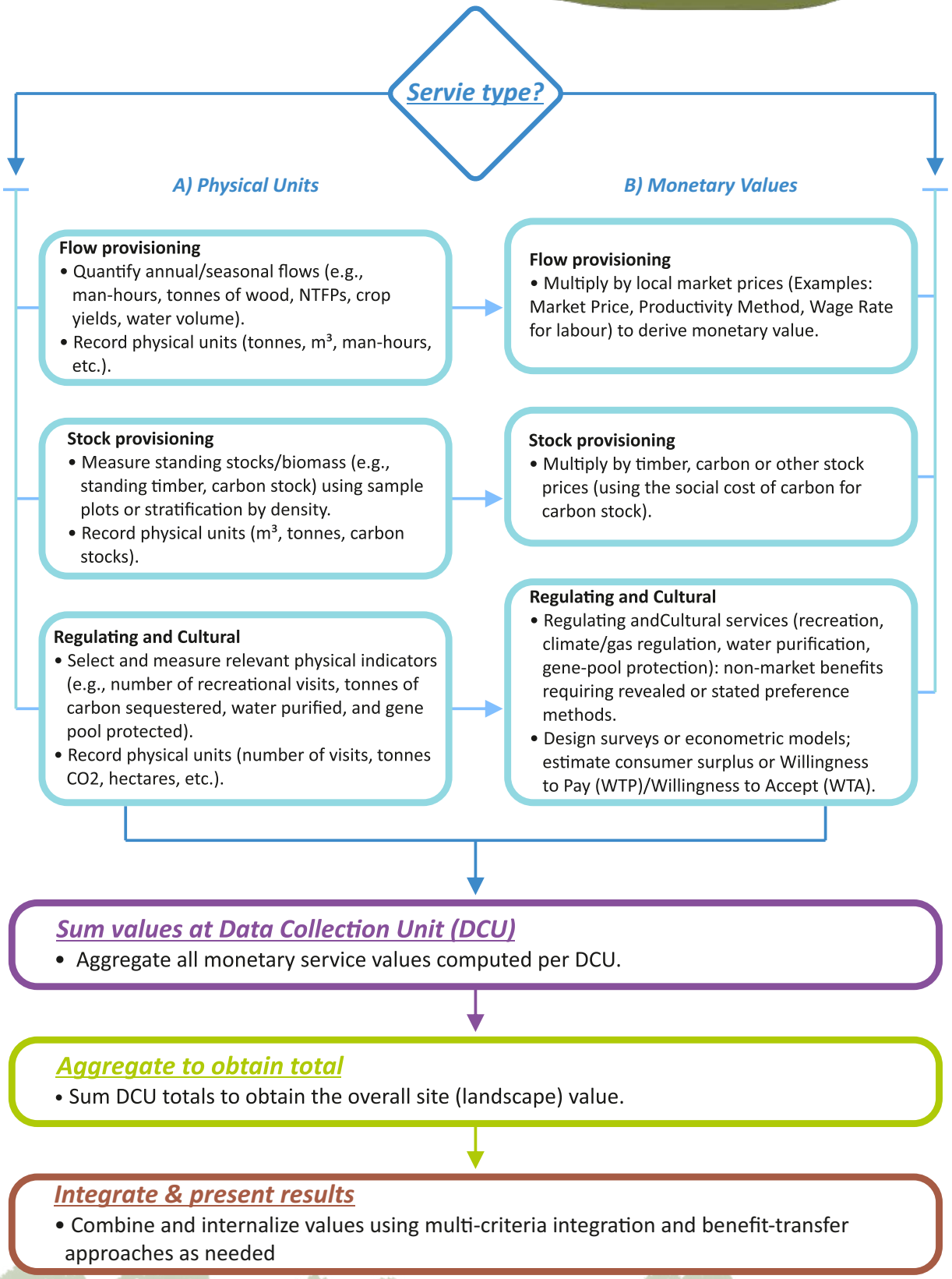
- Social Cost of Carbon: For carbon sequestration/regulation.
- Avoided Cost Method: Value of damage or cost avoided due to ecosystem function.
- Replacement Cost: Cost to replace the ecosystem service (e.g., building water treatment for wetland purification).
- Travel Cost Method: For recreation value, based on travel expenses.
- Contingent Valuation: Survey-based, asks for willingness-to-pay for non-market services.
- Choice Experiments: Survey-based, uses hypothetical scenarios for multiple services.
- Market based methods: Market Price, Productivity Method, Wage Rate for labour.

Based on Valuation method, identification of beneficiaries & service-specific units

- Determine who/what uses each service (jobs, households, livestock, visitors, carbon pools, water users, etc.).

Data collection

- Generate land-use/watershed maps; conduct field surveys; gather secondary data from government and literature.


Servie type?
A) Physical Units
B) Monetary Values
Flow provisioning
• Quantify annual/seasonal flows (e.g., man-hours, tonnes of wood, NTFPs, crop yields, water volume).
• Record physical units (tonnes, m³, man-hours, etc.).
Flow provisioning
• Multiply by local market prices (Examples: Market Price, Productivity Method, Wage Rate for labour) to derive monetary value.
Stock provisioning
• Measure standing stocks/biomass (e.g., standing timber, carbon stock) using sample plots or stratification by density.
• Record physical units (m³, tonnes, carbon stocks).
Stock provisioning
• Multiply by timber, carbon or other stock prices (using the social cost of carbon for carbon stock).
Regulating and Cultural
• Select and measure relevant physical indicators (e.g., number of recreational visits, tonnes of carbon sequestered, water purified, and gene pool protected).
• Record physical units (number of visits, tonnes CO2, hectares, etc.).
Regulating and Cultural
• Regulating andCultural services (recreation, climate/gas regulation, water purification, gene-pool protection): non-market benefits requiring revealed or stated preference methods.
• Design surveys or econometric models; estimate consumer surplus or Willingness to Pay (WTP)/Willingness to Accept (WTA).
Sum values at Data Collection Unit (DCU)
• Aggregate all monetary service values computed per DCU.
Aggregate to obtain total
• Sum DCU totals to obtain the overall site (landscape) value.
Integrate & present results
• Combine and internalize values using multi-criteria integration and benefit-transfer approaches as needed

2.30 Understanding Forest Indicators at a Glance

This table compiles all key indicators along with their definitions, benchmarks, and desired trends sourced primarily from government guideline documents where available, or alternatively from relevant international agency publications.

Each indicator reflects an essential aspect of forest accounting, offering insights into the state and services of our forests.

Table 2.4 Key Indicators of Forest Account

Indicators	*Definition*	*Reference Level*	*Expected Trend*
Forest Asset Account			
Net change	Change in the forests and tree cover each year.	Add 200,00 ha of forests and tree cover per year[27]	↑
Extent Account			
Recorded Forest Area (RFA)	Legally recorded forest land, regardless of actual tree cover.		↑
% of GA	Percentage of a state or country's land is officially covered by forests.	>33% of GA	↑
Type of Protection			
Reserved Forests (RF)	Forests with the highest legal protection		↔ or ↑
Protected Forest (PF)	Forests with moderate protection; some local rights like grazing or collection may be permitted.		↑
Unclassed Forests	Forest land not classified under RF or PF; often without formal status		↓
Forest Cover Class			
Very Dense Forest (VDF)	70% and more of the land area is covered with tree canopy.	Continuous increase because they represent the healthiest forests.	↑

[27]https://www.un.org/esa/forests/wp-content/uploads/2021/08/Global-Forest-Goals-Report-2021.pdf J0nv0gYuA%3D%3D

Indicators	Definition	Reference Level	Expected Trend
Moderately Dense Forest (MDF)	Forest areas where the canopy cover ranges between 40% and 70%	Maintain/ > current level (transition to VDF)	↑
Open Forest (OF)	Forests where trees are more scattered or sparse (10-40% canopy cover).	< current level (transition to MDF)	↓
Scrub	Lands with small bushes or very short plants-not proper forests.	< current level (transition to OF)	↓
Non-Forest	Lands with no forests at all-cities, farms, deserts, etc.	< current level	↓
Condition Accounts			
Growing Stock [How much wood (timber) is present. It's also proxy for carbon storage and forest productivity.]			
Volume of Growing Stock (Million cum)	Total amount of wood stock present in living trees, usually measured in cubic meters (m^3).	Increase volume-healthy forests produce more biomass and store more carbon.	↑
Growing Stock in Forest (Cum/ha)	It reflects how much wood is available in a standard area-serving as a measure of forest density and health.	Continuous increase - shows good forest regeneration and growth.	↑
Carbon Stock (Total) [Total amount of carbon stored in a forest ecosystem, both in plans and soil.]			

Indicators	Definition	Reference Level	Expected Trend
Above-Ground Biomass (AGB)	Carbon in tree trunks, branches, and leaves.	Increase total stock to enhance forests' role as carbon sinks in climate change mitigation. SOC and AGB are most crucial for long-term carbon retention and biodiversity.	↑
Below-Ground Biomass (BGB)	Carbon in roots.		
Deadwood and Litter	Fallen branches, leaf litter, dead logs.		
Soil Organic Carbon (SOC)	Carbon in soil from decayed plants.		
Carbon Stock per hectare (Total)	The amount of carbon stored in one hectare of forest. Measured in tons of carbon per hectare (t C/ha). It helps assess how efficient and healthy a forest is in storing carbon.	>100 t C/ha (Global average for tropical forests: 100–150 t C/ha) as normative target	↑
Forest Fragmentation [How forests are divided into separate patches due to deforestation, roads, or development.]			
≥0.01≤1.0 >0.976≤10 km²	Very small patches	Reduce small fragments and restore large,	↓ (Reduce—too fragmented)

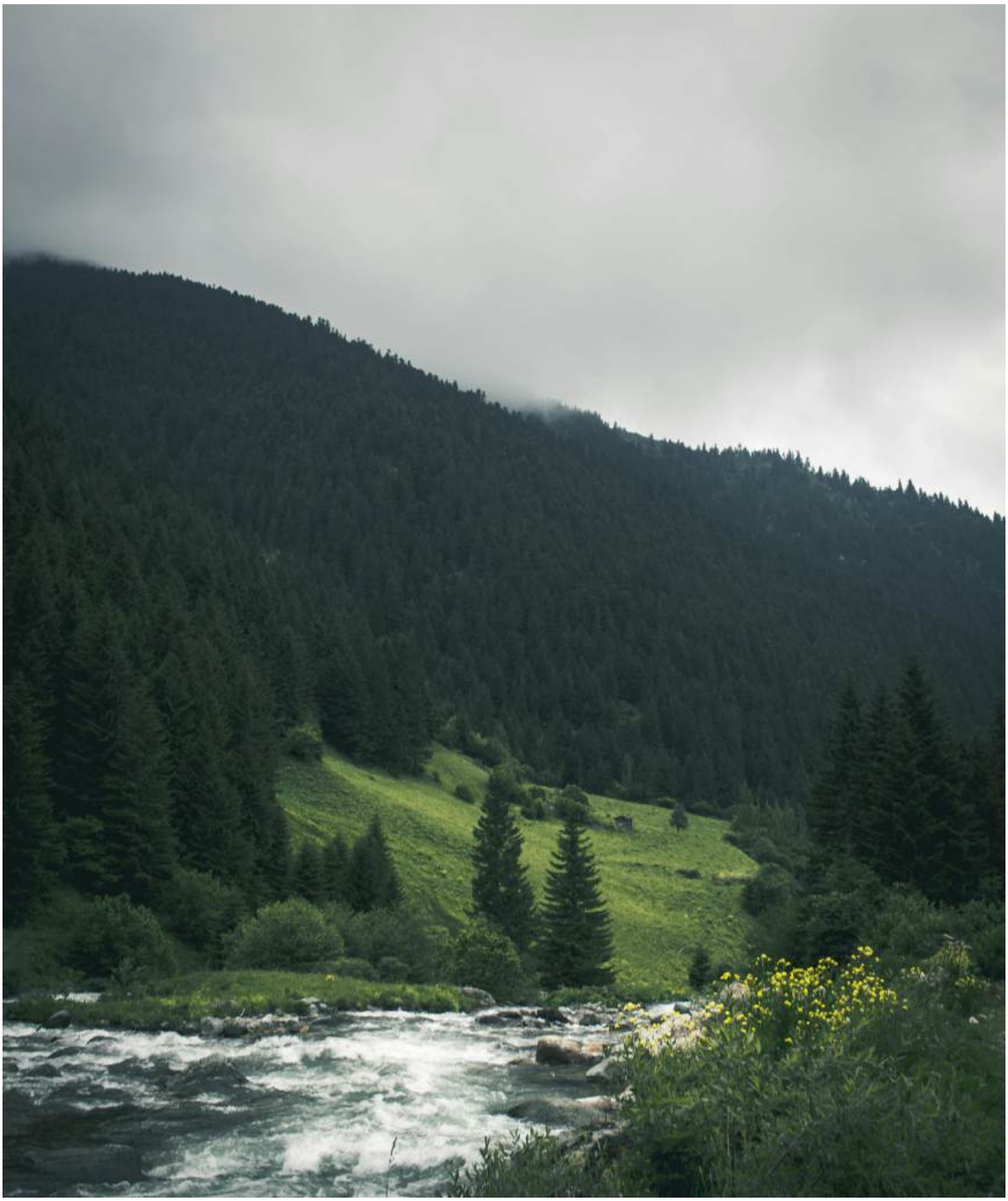
Indicators	Definition	Reference Level	Expected Trend
>10 ≤ 100 km²	Small patches	continuous forest patches. Larger, connected forests support more wildlife, are more climate-resil ient, and provide stable services	↔ or ↓
>100 ≤500 km²	Medium patches		↑
>500 ≤1000 km²	Large patches		↑
>1000 ≤ 5000 km²	Large patches		↑
>5000 ≤1000 km²	Very large patches		↑
>10000 km²	Mega patches (intact forests)		↑
Forest Fires	Measures how often forest fires happen. Fewer fires = healthier forests.	Benchmark to reduce hotspots below historical 5-year average	↓
Forest Fire Prone Classes			
Extremely fire prone	Categories that show how likely a forest is to catch fire-from extremely prone to less prone.	Minimize spread	↓
Very highly fire prone			↓
Highly fire prone			↓
Moderately fire prone		Maintain or reduce with early alerts	↔ or ↓
Less fire prone		Maximize share through fuel management & restoration	↑
Status of Regeneration (Shows whether forests are growing back naturally after being cut or damaged.)			

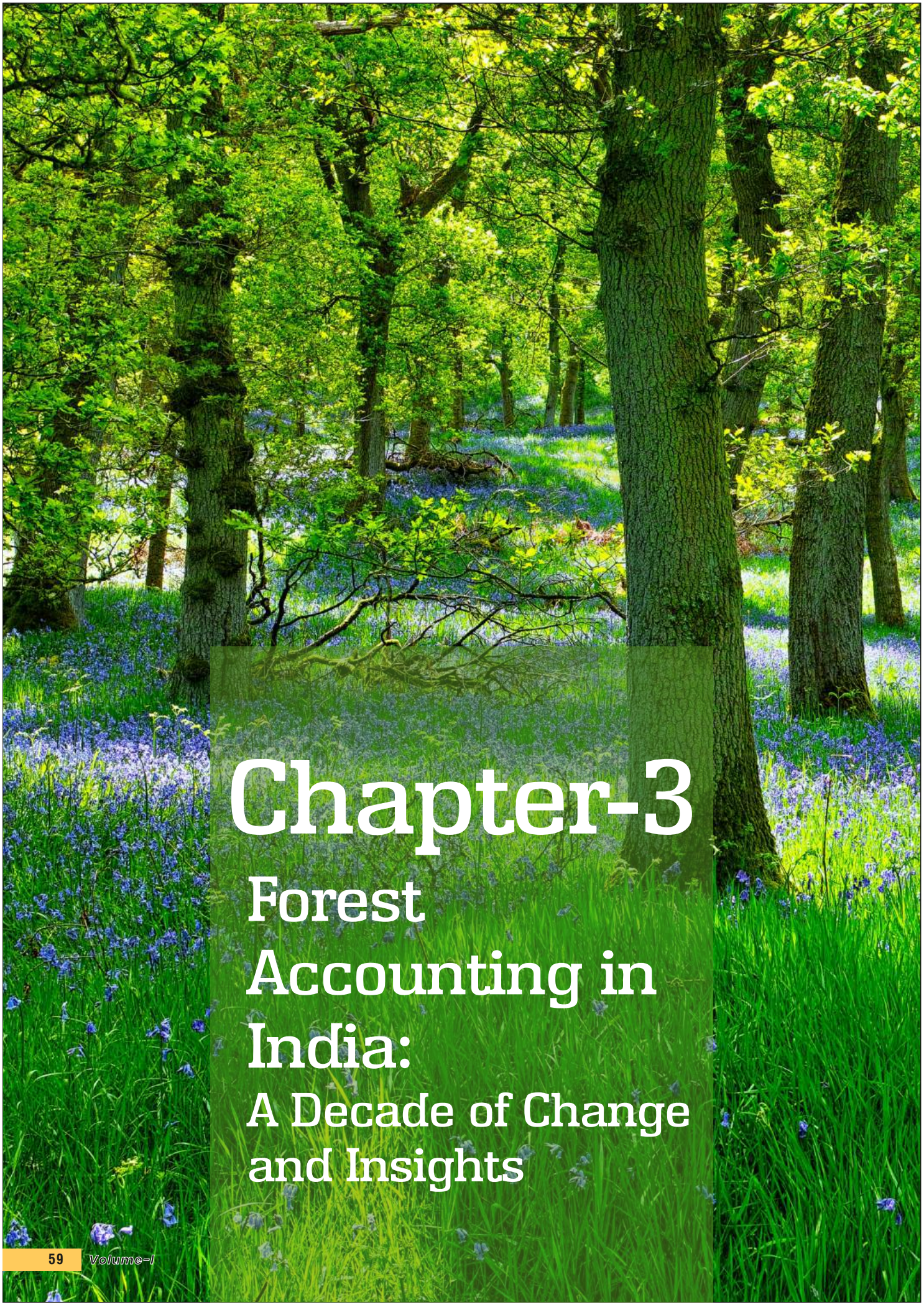
Indicators	Definition	Reference Level	Expected Trend
Adequate	Forests are naturally regenerating well, with seedlings and young trees growing healthily	Maximize Share as adequate regeneration is a "preconditio n" for India's Bonn Challenge pledge to restore 26 million ha of degraded land by 2030.	↑
Inadequate	Regrowth is patchy or insufficient; native species are present but not thriving		↑
Absent	No visible regrowth; forest floor is barren or overrun by weeds/invasives	Minimize Share	↓
Biotic Influence [Impact of animals, insects, or human activities that damage forests (like grazing, cutting trees).]			
Heavily degraded	Forest shows severe damage from grazing, logging, or human use; canopy and soil are disturbed.	Minimize share to meet the target of at least the prioritized 30 % areas of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration.	↓ (control & remove)
Moderately degraded	Signs of partial degradation like reduced regeneration or soil compaction		↓
Mildly degraded	Forest is slightly disturbed but retains most of its ecological function		↔ or ↓
Not degraded	Forest is in natural, undisturbed condition	Maximize share	↑
Invasive Species			

Indicators	Definition	Reference Level	Expected Trend
Very Dense	Non-native plants or animals that harm the forest by taking over native ones.	Reduce in the Introduction of Invasive Alien Species by 50% and Minimize Their Impact.	↓ (control & remove)
Dense			↓
Moderate			↓
Scanty			↔ or ↓
Absent			↑
Wetlands within RFA	Areas in forests that are swampy or waterlogged with important for biodiversity and water storage.	1-5% of forest land as a normative target based on wetland as percentage of GA of India.	↑ (increase wetland retention) ↑ (priority zones)
Biodiversity Assessment (Herb, Shrubs and Trees) *[different types of plants (herbs, shrubs, trees) in a forest. More types = healthier forests]*			
Total Number of species		Maintain or increase total flora species richness	↑
Shannon Weiner Index	It indicates how many different types of plants (like herbs, shrubs, and trees) are in a forest and how evenly they are spread out. If a forest has many species and no single species dominates, the index will be high. If the forest has only a few species, or one species is found much more than the others, the index will be low.	$H' > 2.5$ indicates moderate to high diversity	↑
Effective number of species (ENS)	ENS indicate whether biodiversity is dominated by a few species or well-balanced across many. A higher ENS means the ecosystem has both many species and even distribution, which indicates greater ecological stability and resilience.	ENS = $\exp(H')$ where H' = Shannon-Wiener Index. ENS value of >10–12	↑

Indicators	Definition	Reference Level	Expected Trend
		(derived from H′ > 2.5) indicates moderate to high diversity in vegetation structure.	
Ecosystem Services Accounts			
Value of output of Industrial wood (forest and trees outside forest)	Value obtained from selling wood used in industries (furniture, paper, etc.).	Increase sustainable yield. Sustainable yield as the Volume logged above the net natural growth[28].	↑
Value of Timber Provisioning Services	Total economic value of wood forests	Increase sustainable yield	↑
Value of output of non-timber forest products	Value obtained from forest items like honey, fruits, leaves, or bamboo.	Increase	↑
Value of non-timber forest products	Total value of all forest resources other than timber.	Increase	↑
Value of Carbon Retention Service	Monetary value of the forest's ability to capture and store carbon dioxide from the atmosphere.	Increase and monetize carbon retention through afforestation and improved forest management	↑

[28]https://www.mospi.gov.in/sites/default/files/publication_reports/Green_National_Accouts_in_India_1may13.pdf





Chapter-3

Forest Accounting in India:

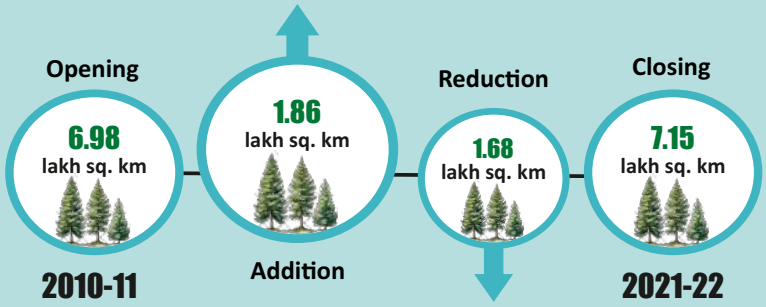
A Decade of Change and Insights

FOREST EXTENT ACCOUNT

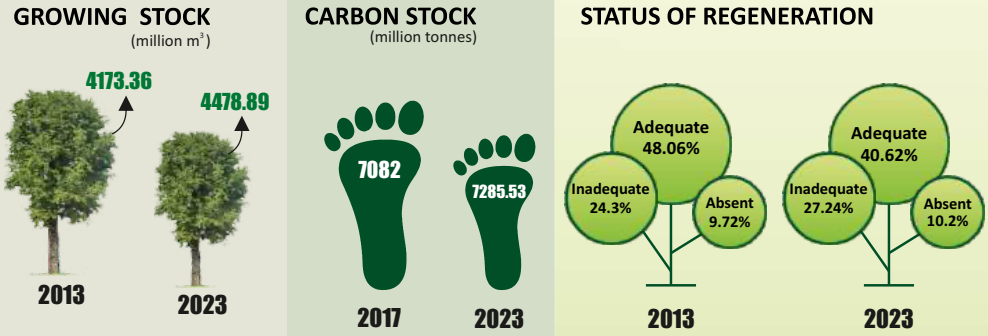
GEOGRAPHICAL AREA	RECORDED FOREST AREA	
2023	2013	2023
32.87 Lakh Sq. Km	23.48%	23.59%

FOREST PHYSICAL ASSET ACCOUNT

(Total Forest Cover)



FOREST CONDITION ACCOUNT



FOREST ECOSYSTEM SERVICE ACCOUNT

(% of SGDP)

PROVISIONING SERVICES

Total Timber + NTFP Services

2011-12	0.35%
2021-22	0.16 %

REGULATING SERVICES

Carbon Retention Service

2015-16	2.97%
2021-22	2.63%

This chapter brings forest accounting in Indian context. It accounts for all key forest-related indicators showing how India's forest resources have changed over the last 10 years. It uses data from ISFR, FSI, and the NCAVES project and formulates accounting based on international systems (SEEA-CF and SEEA-EA) to help us understand forest area, health, value, and the benefits they provide. The year mentioned under the Extent and Condition accounts refers to the respective ISFR publication year from which the data is sourced. For other accounts, the data corresponds to the period specified.

(A) Forest Physical Asset Account

TYPES OF FOREST COVER CLASS (in Sq. Km)	Very Dense Forest	Moderately Dense Forest	Open Forest	SCRUB	Non-Forest
OPENING 2010-11	83502	318745	295651	41383	2547982
ADDITION	29839.2	53701.83	102225.72	35669.14	78804.98
REDUCTION	10839	64773.55	92709.59	33429.5	98283.35
CLOSING 2021-22	102502.2	307673.28	305167.13	43622.64	2528503.63
NET CHANGE	19000.2	-11071.72	9516.13	2239.64	-19478.37
% CHNAGE	22.75%	-3.47%	3.22%	5.41%	-0.76%

Note: The calculation has been done by MoSPI using data from the India State of Forest Report (ISFR). For the methodology, please refer to section 2.2 of chapter 2.

The Forest Physical Asset Account tracks the actual area under different forest cover categories-like Very Dense Forests, Moderately Dense Forests, Open Forests, Scrub, and Non-Forest land-over time. It shows how much forest India has and how it's changing physically due to natural growth, conservation, deforestation, or land use changes. In this account, "Addition" means the increase in forest cover, either through plantation, natural regeneration, or reclassification. "Reduction" refers to the decrease in forest cover due to degradation, diversion for other land uses, or poor regeneration. The comparative assessment from 2010-11 to 2021-22 reveals mixed trends in forest cover changes. Between 2010-11 and 2021-22, India saw a strong increase in Very Dense Forests (22.75%), showing effective regeneration and conservation. Open Forests and Scrub also rose slightly (3.22% and 5.41%), indicating partial recovery in degraded areas. However, Moderately Dense Forests declined by 3.47%, which is a concern, as recommended standards emphasize the need to maintain or enhance this category. Non-Forest area dropped by 0.76%, a positive sign of land shifting back to forest use.

(B) Extent Account

Indicator	Unit	2013	2023	Net Change	% Change
Recorded Forest Area (RFA)	sq. km	771821	775377	3556	0.46%
Geographical Area (GA)	Lakh sq. km	32.87	32.87		
% of GA		23.48	23.59	0.11	
Type of Protection					
Reserved Forests (RF)	sq. km	425494	443253	17759	4.17%
Protected Forest (PF)	sq. km	214986	212859	-2127	-0.99%
Unclassed Forests	sq. km	131341	119265	-12076	-9.19%

Source: India State of Forest Report (ISFR), Forest Survey of India (FSI), Ministry of Environment, Forest and Climate Change

The extent of forest area in India is assessed based on the Recorded Forest Area (RFA), which comprises all land legally notified as forest, regardless of actual tree cover or canopy density. RFA forms the cornerstone of the country's forest governance structure, offering a clear legal and administrative framework to define and manage forest boundaries effectively. Between 2013 and 2023 assessment period, India's total RFA recorded a net increase of 0.46%, signalling a gradual expansion in the area brought under legal forest status. The RFA is further divided into three categories: Reserved Forests (RF), Protected Forests (PF), and Unclassed Forests. Of these, Reserved Forests, which are under the highest legal protection with limited public access, increased by 4.17%. This gain reclassification and boundary corrections, indicating possible shift toward stricter legal protection and long-term conservation planning. On the other hand, Protected Forests saw a slight decline of 0.99%, while Unclassed Forests dropped by 9.19%, suggesting a move away from loosely regulated forest categories. These reductions may result from conversion, better categorization, or increased protection under the Reserved Forests category.

Area under different Forest Type Groups of India

Sl. No.	Type Group	Area in sq. km	Area in sq. km	Net Change	% Change
		2019	2023		
1	Group 1 - Tropical Wet Evergreen Forests	20054	23888	3834	19.12%
2	Group 2 – Tropical Semi-Evergreen Forests	71171	63886	-7285	-10.24 %
3	Group 3 – Tropical Moist Deciduous Forests	135492	133187	-2305	-1.70%
4	Group 4 – Littoral & Swamp Forests	5596	5611	15	0.27%

5	**Group 5 – Tropical Dry Deciduous Forests**	313617	280580	-33037	-10.53 %
6	**Group 6 – Tropical Thorn Forests**	20877	13755	-7122	-34.11 %
7	**Group 7 – Tropical Dry Evergreen Forests**	937	801	-136	-14.51 %
8	**Group 8 – Subtropical Broadleaved Hill Forests**	32706	31017	-1689	-5.16%
9	**Group 9 – Subtropical Pine Forests**	18102	18108	6	0.03%
10	**Group 10 – Subtropical Dry Evergreen Forests**	180	138	-42	-23.33 %
11	**Group 11 – Montane Wet Temperate Forests**	20435	19445	-990	-4.84%
12	**Group 12 – Himalayan Moist Temperate Forests**	25743	29815	4072	15.82%
13	**Group 13 – Himalayan Dry Temperate Forests**	5627	4487	-1140	-20.26 %
14	**Group 14 – Sub Alpine Forests**	14995	12498	-2497	-16.65 %
15	**Group 15 – Moist Alpine Scrub**	959	534	-425	-44.32 %
16	**Group 16 – Dry Alpine Scrub**	2922	2082	-840	-28.75 %

Note: Data on Forest type group is available from ISFR 2019

India's forest ecosystems are classified into 16 major forest type groups based on their vegetation structure, climatic conditions, and ecological functions. These include tropical, subtropical, temperate, and alpine forest formations. An assessment of the changes in these forest type groups between 2019 and 2023 assessment period of ISFR reveals both positive and concerning trends, which are critical for guiding conservation strategies and regional forest management policies. A significant increase was observed in Tropical Wet Evergreen Forests (+19.12%) and Himalayan Moist Temperate Forests (+15.82%), while minor gains were also seen in Littoral & Swamp Forests and Subtropical Pine Forests. However, several forest types recorded notable declines. Moist alpine scrub saw the largest reduction, followed by losses in Tropical Semi-Evergreen, Thorn, and Moist Deciduous Forests.

(C) Condition Accounts

Growing Stock					
Indicator	**Unit**	**2013**	**2023**	**Net change**	**% change**
Volume of Growing Stock	Million m^3	4173.362	4478.89	305.53	7.32%
Growing Stock in Forest per unit area	m^3/ha	-	86.1		

The growing stock is a key measure of the condition of forests, showing how much usable wood exists in living trees. From 2013 and 2023 assessment period of ISFR, India's volume of growing stock increased by 305.53 million cubic meters-a 7.32% rise, which is a positive sign. This means forests are producing more biomass and storing more carbon, aligning with the goal of enhancing forest productivity and ecological performance. Also, the growing stock density reached 86.1 cubic meters per hectare in 2023, indicating healthy regeneration and better forest conditions overall. These improvements suggest that India's forests are becoming denser and more productive.

Carbon Stock					
Indicator	**Unit**	**2017**	**2023**	**Net change**	**% change**
Total	Million tonnes	7082	7285.53	203.53	2.87%
Above Ground Biomass	Million tonnes	2238	2374.38	136.38	6.09%
Below -Ground Biomass	Million tonnes	699	735.16	36.16	5.17%
Dead Wood	Million tonnes	30	56.45	26.45	88.17%
Litter	Million tonnes	136	107.80	-28.2	-20.74%
Soil Organic Carbon	Million tonnes	3979	4011.75	32.75	0.82%

The carbon stock in India's forests-a key indicator of the condition of forests and their ability to fight climate change-increased by 2.87% from 2017 and 2023 assessment period This improvement shows that forest ecosystems are becoming healthier and better at storing carbon. This is further supported by the growth in various carbon pools that reflect both above-ground and below-ground forest strength. Above Ground Biomass (AGB), which includes carbon stored in tree trunks and branches, grew by 6.09%, and Below Ground Biomass (roots) increased by 5.17%, both indicating improved forest quality and enhanced capacity for carbon storage. A sharp 88.17% rise in Dead Wood. Soil Organic Carbon (SOC), important for long-term carbon storage, also grew slightly by 0.82%, suggesting stable soil health. However, Litter stock declined by 20.74%, pointing to possible changes in surface vegetation or decomposition. Overall, this positive trend reflects improving forest conditions and supports India's goals for climate resilience and biodiversity conservation.

DO YOU KNOW?

2024 Global Assessment was conducted by UNSD as an abbreviated assessment. According to the results of the 2024 Global Assessment, 94 countries have implemented the SEEA. India is at stage-III which publishes at least one account on a regular basis.

Carbon Stock per hectare					
Indicator	**Unit**	**2017**	**2023**	**Net change**	**% change**
Total Carbon Stock per hectare	Per hectare stock in tonnes	99.99	101.85	1.86	1.86%
Above Ground Biomass	Per hectare stock in tonnes	31.59	33.19	1.6	5.06%
Below Ground Biomass	Per hectare stock in tonnes	9.86	10.28	0.42	4.26%
Dead Wood	Per hectare stock in tonnes	0.43	0.79	0.36	83.72 %
Litter	Per hectare stock in tonnes	1.92	1.51	-0.41	-21.35 %
Soil Organic Carbon	Per hectare stock in tonnes	56.19	56.08	-0.11	-0.20 %

Note: Data for carbon stock per hectare is available from ISFR 2017 and subsequent years

The carbon stock per hectare is an important measure of how much carbon each unit area of forest can store, reflecting the condition and productivity of the forest. Between 2017 and 2023 assessment period, this value increased from 99.99 to 101.85 tonnes per hectare as its in line with average tropical forest carbon stocks[29]. Above Ground Biomass (AGB), which includes trunks and branches, rose by 5.06%, and Below Ground Biomass (roots) increased by 4.26%, indicating healthy forest growth. A sharp rise of 83.72% in Dead Wood suggests maturing forests, while a small drop in Litter and Soil Organic Carbon (SOC) points to slight changes in surface matter and soil condition. Still, the overall improvement shows better forest health and stronger ability to fight climate change.

[29]https://redd.unfccc.int/uploads/2_112_redd_20081022_tfg.pdf

Forest Fragmentation								
Indicator	**Unit**	**2015**			**2017**			**Net Change**	**% Change**
Average forest patch size #	Sq. Km	0.74			0.95			0.21	28.23
Proportion of small patches (≥ 0.01 sq. km to 1 sq. km) #	%	98.18			97.45			-0.73	-0.74
Patch Size Range (in sq. km)		**No of Patches**	**Forest Cover**	**Percentage**	**No of Patches**	**Forest Cover**	**Percentage**	**Net change in % of patch size range**	
≥0.01 ≤ 1.0		935864	50494	7.2	727380	54082	7.64	0.44	
>1.0 ≤ 10		14957	40583	5.78	16444	43639	6.16	0.38	
>10 ≤ 100		2056	57675	8.22	2183	58052	8.2	-0.02	
>100 ≤ 500		240	48476	6.91	257	51298	7.24	0.33	
>500 ≤ 1000		58	40109	5.72	57	39628	5.59	-0.13	
>1000 ≤ 5000		45	92041	13.12	42	85407	12.06	-1.06	
>5000 ≤ 10000		15	62718	13.21	14	90028	12.71	-0.5	
>10000		9	279577	39.84	9	286139	40.4	0.56	
Total		953244	701673	100	746386	708273	100		

Source: Data on Forest fragmentation is available in ISFR 2015 and 2017.

 # Note: The calculation has been done by MoSPI using data from India State of Forest Report (ISFR). For the methodology, please refer section 2.9 in chapter 2.

Forest fragmentation means forests are breaking up into smaller pieces instead of staying as one contiguous area. The goal is to have less Number of these very small patches (having size between about 1 and 10 square kilometres) and more connected forests, because larger forests are better for wildlife and for the environment. According to the data, the average forest patch size has increased from 0.74km^2 in 2015 assessment period to 0.95 km^2 in 2017 assessment period . At the same time,

large forest patches became fewer: for example, patches between 1,000 to 5,000 km² dropped from 13.21% to 12.06%. Even though nine very large patches (over 10,000km²) were recorded in 2017.

Forest Fires					
Number of Forest Fire Detected by FSI using	**Unit**	**Nov 2018 to June 2019**	**Nov 2021 to June 2022**	**Net change**	**% change**
MODIS Detections	Number	29547	29675	128	0.43%
SNPP-VIIRS Detections	Number	210286	223333	13047	6.20%

Between 2018-19 and 2021-22, fire detections, MODIS (Moderate Resolution Imaging Spectroradiometer), known for capturing global fire activity at a coarse resolution, showed a 0.43% rise, while SNPP-VIIRS, (Suomi National Polar-orbiting Partnership - Visible Infrared Imaging Radiometer Suite), which provides finer resolution and improved sensitivity and has higher sensitivity, showed a 6.2% rise. The trend may indicate either an increase in fires, improvements in detection, or a combination of both.

Forest Fire Prone Classes (% of Total Forest Cover and Scrub)				
Indicator	**Unit**	**2019**	**2023**	**Net change %**
Extremely fire prone	%	3.89	1.45	-2.44%
Very highly fire prone	%	6.01	9.89	3.88%
Highly fire prone	%	11.5	16.63	5.13%
Moderately fire prone	%	14.7	15.22	0.52%
Less fire prone	%	63.9	56.81	-7.09%

Note: Data on Forest fire prone class is available from ISFR 2019

The Forest Fire Prone Classes, which categorize areas based on the frequency and intensity of past fires. Looking at fire-prone classes, there is a positive trend: the "Extremely fire prone" area decreased from 3.89% to 1.45%, trend suggested in UNEP's "Spreading Like Wildfire" Report (2020)[30] and the FAO's Fire Management Voluntary Guidelines[31], which aim to minimize fire spread in critical zones. However, the "Very Highly" and "Highly fire prone" categories increased to 9.89% and 16.63%indicating growing risks in those forest areas. Moderately Fire Prone areas increased slightly, whereas Less Fire Prone zones saw a notable decline, indicating a reduction in safer forest zones.

Status of Regeneration [Distribution of RFA (%)]				
Indicator	**Unit**	**2013**	**2023**	**Net Change**
Adequate	%	48.06	40.62	-7.44
Inadequate	%	24.3	27.24	2.94
Absent	%	9.72	10.2	0.48
Not Available	%	17.92	21.94	4.02

The status of regeneration is an important indicator of forest vitality, overall health, and sustainability, reflecting how effectively forests are naturally growing back or artificially regenerated. Between 2013 and 2023 assessment period, the share of areas with adequate regeneration declined from 48.06% to 40.62%. This level remains critically low, given that maximizing regeneration is a necessary precondition for India's Bonn Challenge commitment to restore 26 million hectares of degraded land by 2030[32]. This suggests that the natural recovery ability of forests is weakening. At the same time, inadequate regeneration areas rose to 27.24%, and absent regeneration slightly increased to 10.2%, which is a concern. Overall, the data show that the condition of forest regeneration is declining and highlight the need for better restoration and protection strategies.

[30]https://www.unep.org/resources/report/spreading-wildfire-rising-threat-extraordinary-landscape-fires
[31]https://openknowledge.fao.org/server/api/core/bitstreams/51d550cd-15df-4361-9b23-8d238822f9d8/content
[32]https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1584542

Biotic Influence [Distribution of RFA (%)]				
Indicator	**Unit**	**2013**	**2023**	**Net Change**
Heavily degraded	%	11.05	5.93	-5.12
Moderately degraded	%	20.23	20.73	0.5
Mildly degraded	%	43.3	53.4	10.1
Not degraded	%	13.28	12.26	-1.02
Not Available	%	12.14	7.68	-4.46

Biotic influence refers to the impact of human and animal activities-like grazing, fuel wood collection, encroachment, or unregulated harvesting-on forest health. The classification of biotic influence on India's Recorded Forest Area (RFA) provides insights into the degree of forest degradation. The condition of forests in India, based on biotic influence, has shown some positive changes between 2013 and 2023 assessment period. The Heavily degraded forest areas where damage from activities like grazing and cutting is most severe-reduced from 11.05% to 5.93%, aligns well with aim to keep such areas low to meet the target of at least bringing the prioritized 30% areas of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration[33]. Moderately degraded areas stayed almost the same, while mildly degraded forests increased by 10.1%. On the other hand, not degraded areas slightly decreased by 1.02%, which is not desirable as we aim to maximize healthy, undisturbed forests.

Invasive Species [Distribution on (%) in RFA]		
Indicator	**Unit**	**2023**
Very Dense	%	2.51
Dense	%	10.21
Moderate	%	23.38
Scanty	%	18.92
Absent	%	23.61
NA	%	21.37

Note: NA: Not Available, Data for invasive species is available in ISFR 2023

[33]nbaindia.org/uploaded/pdf/INDIA'sUPDATEDNBSAP.pdf

The condition of forests in India is increasingly affected by invasive species, which are non-native plants or organisms that spread quickly and disturb the natural balance of forest ecosystems. As per the 2023 assessment period data, moderate invasive species was recorded in 23.38% of the forest area. Dense (10.21%) and very dense (2.51%) categories are also present, which are concerning as they severely impact forest regeneration and biodiversity. Scanty invasion was observed in 18.92% and no invasion (absent) was reported in 23.61%, which is a positive sign for forest health. This aligns with Target 6 of the Kunming–Montreal Global Biodiversity Framework (KMGBF), which seeks to achieve a 50% reduction in the introduction of invasive alien species and to minimize their impacts[34].

Indicator	Unit	2019
Wetlands within RFA	Number	62466
	Area (in ha)	2793141
	% of RFA	3.83

Note: Data for wetland is available in ISFR 2019.

The condition of forests in India also depends on the presence of wetlands and the richness of plant biodiversity. As of 2019 assessment period, there were 62,466 wetlands within the Recorded Forest Area (RFA), covering 3.83% of the RFA. While this shows wetlands play an important ecological role, the percentage is still low), highlighting the need to increase and protect these wet zones, which are essential for water storage, biodiversity, and overall forest health.

Biodiversity Assessment			
Indicator	**2019**		
Total Number of species	**Herbs**	**Shrubs**	**Trees**
	2300	3111	3794

Note:Data for Biodiversity assessment is available in ISFR 2019.

[34]https://www.cbd.int/gbf/targets/6

In terms of biodiversity, forests supported 2,300 herb species, 3,111 shrub species, and 3,794 tree species, indicating high species richness, which is a positive sign of a healthy forest condition. This aligns with the objectives of India's National Biodiversity Strategy and Action Plan (NBSAP), which emphasizes the importance of conserving species diversity in forest ecosystems.

Note- The present report primarily analyses the decadal change in forest-related indicators using data from assessment year 2013 to 2023, as available in successive editions of the India State of Forest Report (ISFR). However, for certain indicators, data for the exact decadal range was not available. In such cases, the most recent and relevant data has been taken based on availability in the ISFR, even if it pertains to a shorter time frame. This approach ensures consistency and accuracy while reflecting the latest status and trends.

Source- India State of Forest Report (ISFR), Forest Survey of India (FSI), Ministry of Environment, Forest and Climate Change

(D) Ecosystem Service Account

India's forest sector contributes significantly to the national economy through both timber and non-timber products, as well as critical ecosystem services like carbon retention.

1) *Ecosystem services (at current prices)*

Provisioning services*							
Indicator	**Unit**	**2011-12**	**Imputed value as % of GDP (2011-12)**	**2021-22**	**Imputed value as % of GDP (2021-22)**	**Net Change**	**% Change**
Value of Timber	(₹ in 1000 crore)	15.33	0.18%	24.88	0.11%	9.55	62.26%
Value of non-timber forest products	(₹ in 1000 crore)	15.38	0.18%	13.05	0.06%	-2.34	-15.19%
Total Timber + NTFP services	(₹ in 1000 crore)	30.72	0.35%	37.93	0.16%	7.21	23.47%

**For methodology refer table 2.2 in chapter 1*

During period 2011-12 to 2021-22 The value of timber provisioning services also showed a rise of 62.26%, increasing from ₹15.33 thousand crore to ₹24.88 thousand crore. In contrast, the value of non-timber forest resources declined by 15.19%, decreasing from ₹15.38 thousand crore to ₹13.05 thousand crore, which may points to a reduction of share of NTFP resources in forestry sector, conversion of forests or reduction in the market value . Together, the combined value of timber and non-timber forest provisioning services increased substantially from ₹30.72 thousand crore to ₹37.93 thousand crore, illustrating significant growth in the economic contribution of forest-based extractive products alongside their ecological functions.

Regulating services*							
Indicator	**Unit**	**2015-16**	**Imputed value as % of GDP (2015-16)**	**2021-22**	**Imputed value as % of GDP (2021-22)**	**Net Change**	**% Change**
Value of Carbon Retention Service	(₹ in 1000 crore)	409.1	2.97%	620.97	2.63%	211.96	51.82%

**For methodology refer table 2.3 in chapter 1*

Over the period from 2015-16 to 2021-22, the value of carbon retention services increased significantly by 51.82%, rising from ₹409.1 thousand crore to ₹620.97 thousand crore. This reflects a notable improvement in forest capacity for carbon sequestration and emphasizes the important role of forests in climate change mitigation, aligning with national environmental goals.

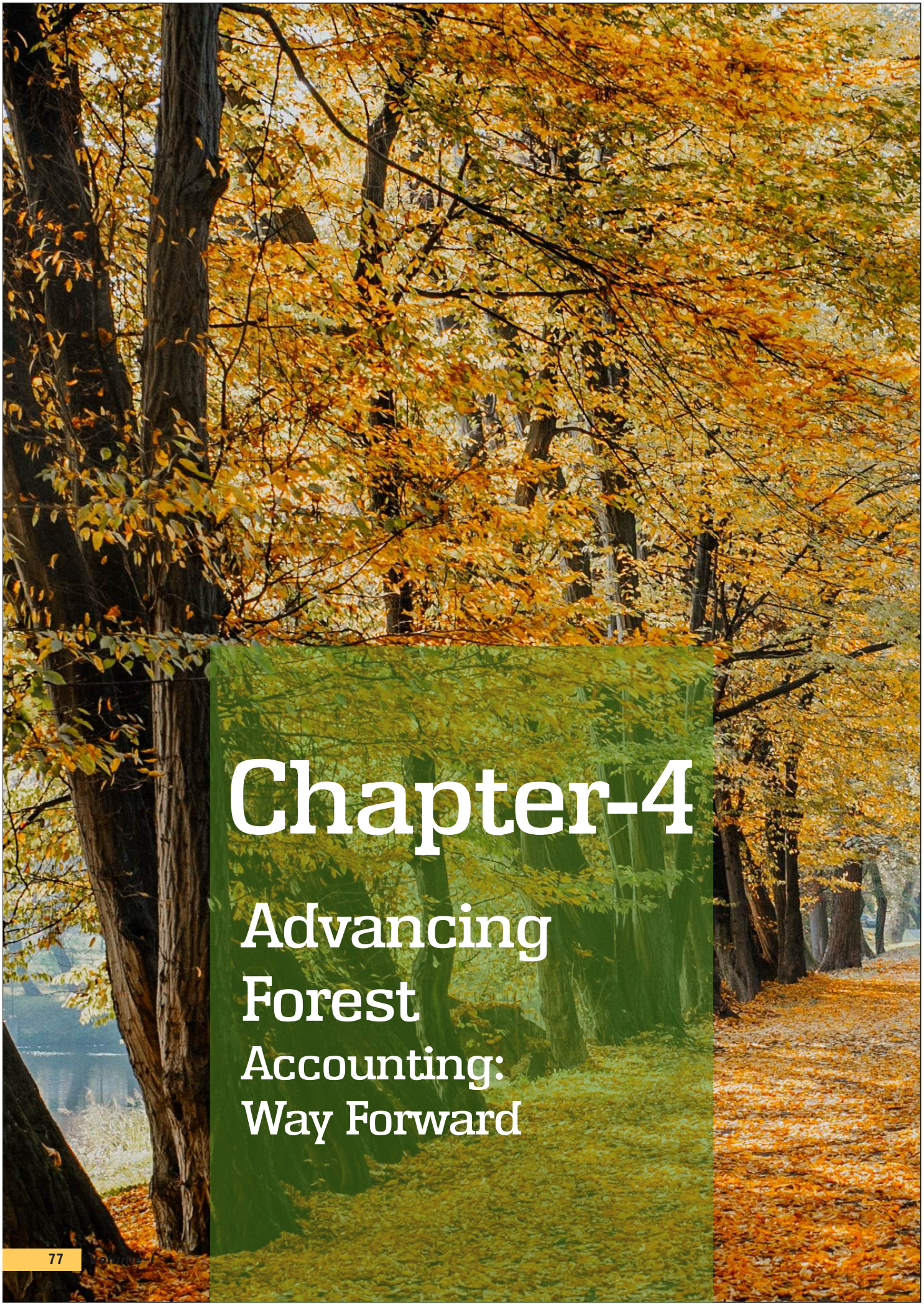
2) Ecosystem services (at Constant prices)

Provisioning services							
Indicator	**Unit**	**2011 -12**	**Imputed value as % of GDP (2011-12)**	**2021-22**	**Imputed value as % of GDP (2021-22)**	**Net Change**	**% Change**
Value of Timber	(₹ in 1000 crore)	15.33	0.18%	16.35	0.11%	1.02	6.63%
Value of non-timber forest products	(₹in 1000 crore)	15.38	0.18%	7.79	0.05%	-7.59	-49.36%
Total timber + NTFPS Services	(₹ in 1000 crore)	30.72	0.35%	24.14	0.16%	-6.58	-21.41%

From year 2011-12 to 2021-22, the value of non-timber forest resources declined substantially by 49.36%, decreasing from ₹15.38 thousand crore to ₹7.79 thousand crore. This significant drop reflects a contraction in the market valuation or supply of these resources. During the decade from 2011-12 to 2021-22, Timber provisioning services showed a modest increase of 6.63%, increasing from ₹15.33 thousand crore to ₹16.35 thousand crore, suggesting stable and sustainable use aligned with forest health benchmarks. Overall, the combined value of timber and non-timber forest provisioning services declined from ₹30.72 thousand crore to ₹24.14 thousand crore, indicating a reduction in the overall value of forest provisioning services.

Regulating Services							
Indicator	**Unit**	**2015-16**	**Imputed value as % of GDP (2015-16)**	**2021-22**	**Imputed value as % of GDP (2021-22)**	**Net Change**	**% Change**
Value of Carbon Retention Service	(₹ in 1000 crore)	247.17	2.17%	254.27	1.69%	7.10	2.87%

At constant prices, the value of carbon retention services marginally increased by 2.87%, rising from ₹247.17 thousand crore in 2015-16 to ₹254.27 thousand crore in 2021-22. This indicates that forests have improved their ability to capture carbon and contribute to climate regulation.



Chapter-4

Advancing Forest Accounting: Way Forward

KEY MESSAGES

- MoSPI initiated compiling SEEA-compliant accounts in 2018 which has now become a regular feature covering various ecosystems and assets viz. land, water, soil, minerals, energy, forests, ocean.
- The way forward involves broadening the scope of environmental accounting for forests to more systematically incorporate forest ecosystem services and stock assessments.
- Targeted efforts to develop more refined datasets and improve the availability of state-level and ecosystem-specific information can lead to a more detailed and accurate representation of forest wealth.
- States and Union Territories should prioritize developing a phased roadmap to integrate forest ecosystem accounting, including the regular compilation of accounts for forest extent, condition, and ecosystem services.
- By enhancing institutions, upgrading data infrastructure, and integrating valuation methods into standard practice, forest accounting can serve as a powerful tool for monitoring and planning

India's forests spanning from the Himalayas to the Western Ghats, are rich in biodiversity and play a vital role in supporting both ecological stability and economic development. Forest ecosystems offer a wide range of essential services, broadly classified into three categories with provisioning regulating, and cultural services. Provisioning services include critical resources such as fuelwood, fodder, timber, and non-timber forest products, which also contribute to rural employment and livelihood generation. Regulating services help maintain ecological balance by supporting carbon sequestration, water purification and supply, gene-pool protection, biological pest control, pollination, gas regulation, waste assimilation, flood regulation, and soil conservation. Supporting services, such as nutrient cycling and habitat provision, are crucial for sustaining biodiversity and long-term ecosystem health. Cultural services offer recreational and tourism benefits, adding social and economic value to forest landscapes. However, these benefits are not reflected in the country's National Accounting System for the reason that many nontangible services often do not have a price-tag attached to them.

India's adoption of the SEEA-Central Framework (SEEA-CF) and SEEA Ecosystem Accounting (SEEA-EA) represents a major step towards integrating natural capital into economic planning. These frameworks enable the structured collection and use of environmental data, supporting more informed and sustainable policy decisions. By aligning with global standards, India has established a strong foundation for natural resource accounting and created models that can be replicated across states and sectors. Strengthening the implementation of SEEA through institutional coordination, technical capacity-building, and policy support is essential for promoting sustainable, inclusive, and evidence-based environmental governance.

As outlined by the SEEA, the framework for environmental accounting of forest is structured around compilation of four key accounts. . The first component is asset which records physical and monetary value of forest resources.

Second component is Extent, which records the total area under forests and classifies them as reserved, protected, or unclassed forests. The third component is Condition, which focuses on evaluating the health of forest ecosystems. This is done by examining indicators such as the volume of growing stock, levels of carbon stored in forest biomass, the presence of wetlands within forested areas, biodiversity status, and the extent of forest fragmentation. The fourth component is Services, which captures the benefits forests provide to people. These services include the provisioning of timber and non-timber forest products, the regulation of carbon through retention and storage, and the cultural benefits derived from Ecotourism as mentioned in this report. To develop these accounts, available national datasets were reviewed, and in the initial phase, estimates were prepared at current prices. Over time, estimates were also calculated at constant prices to reflect real values. In some instances, global data sources were used to fill gaps where national data were unavailable.

MoSPI initiated compiling SEEA-compliant accounts in 2018 which has now become a regular feature covering various ecosystems and assets viz. land, water, soil, minerals, energy, forests, ocean. In the current report, a comprehensive assessment of forest has been presented in respect of compilation of forest assets, extent and condition accounts in accordance with the System of Environmental-Economic Accounting (SEEA) framework. It also presents estimation of the monetary value of selected forest ecosystem services, specifically timber provisioning, non-timber forest resources, carbon retention and eco-tourism using robust data sources and valuation methods consistent with the System of National Accounts, ensuring alignment with national economic statistics. Moving forward, there are still several important indicators of extent, condition and ecosystem services provided by forests which have not been included in this assessment, but are nevertheless, very important. The way ahead involves expanding the scope of national accounting to incorporate forest ecosystem services and stocks more systematically. It also calls for improving the spatial and temporal resolution of data on forest extent and condition, enabling the derivation of site-specific shadow prices and wealth estimates.

In the extent accounts, important indicators such as afforestation and reforestation, when captured annually in hectares, could be treated as capital formation, while deforestation could be considered as depreciation of natural capital. These indicators may be derived using data from remote sensing technologies, Forest Survey of India's (FSI) wall-to-wall mapping, forest working plans, and administrative records maintained by the Ministry of Environment, Forest and Climate Change. Forest condition accounts, covering health, regeneration, biodiversity, and fragmentation, should also be developed using micro-level geospatial data and ground surveys, allowing for the derivation of site-specific mechanisms that reflect ecological variation across regions.

While market-services of forest remains, the primary asset accounted for, several non-market forest services such as genetic resources, watershed protection, cultural values, and soil erosion prevention are yet to be adequately captured in physical and monetary terms. The integration of eco-tourism as a cultural ecosystem service could also be explored, drawing on data for tourist visitation and the monetary value visitors assign to natural settings, using available methods such as the Travel Cost Method or Contingent Valuation at the national level. Additionally, assessing the soil erosion prevention service through models like the Revised Universal Soil Loss Equation, combined with GIS analysis and replacement cost valuation or any other suitable methods, would provide a more comprehensive picture of forest contributions. Incorporating these services through shadow pricing and benefit-transfer techniques will enrich the SEEA-based accounts.

These unaccounted aspects, though not reflected in the current estimates, are essential for a comprehensive understanding of forest contributions. With the development of more refined datasets and greater availability of state-level and ecosystem-specific information, future efforts can provide a more detailed and accurate representation of forest wealth. A holistic and inclusive assessment is crucial for enabling sustainable forest management and for recognizing the full economic, ecological, and social value of forests in national planning.

Table 4.1: Indicators for Future Integration into Forest Accounting

Accounts as per SEEA Framework	Indicators covered in this report	Indicators for Future Integration *#
Forest Extent Accounts	• Total forest Cover (VDF, MDF, OF (ha), Scrub, Non-Forest) • Tree cover (ha) • Recorded Forest Area (RFA), by type of protection – reserved, protected and Unclassed Forests	• Afforestation/reforestation (ha/year)[35] • Deforestation (ha/year)[36]
Forest Condition Accounts	• Volume of growing stock • Carbon stock, by type of carbon pool- above ground biomass (AGB), below ground biomass (BGB), soil organic carbon (SOC), dead wood and litter • Number and area of wetlands within RFA • Biodiversity assessment • Total number of species of herbs, shrubs and trees • Shannon-Wiener index of herbs, shrubs and trees • Effective number of species (ENS) of herbs, shrubs and trees • Forest Fragmentation: Average patch size, number of patches in different patch sizes classes	• Tree cover density[35] • Soil organic carbon content[36] • Vegetation water content[37] • Soil water availability[37] • Forest connectivity

[35]WAVES Himachal Report (Technical Rept WAVES Himachal 5-29-15 web.pdf) – World Bank, Himachal Forest Dept.
[36]NCAVES India Report (ncaves_india_report_jan21161121016053016123729854 51.pdf) – MoSPI, NCAVES Project
[37]India Assessment 2019 (india_assessment_2019.pdf) – MoSPI National SEEA-EA Assessment.

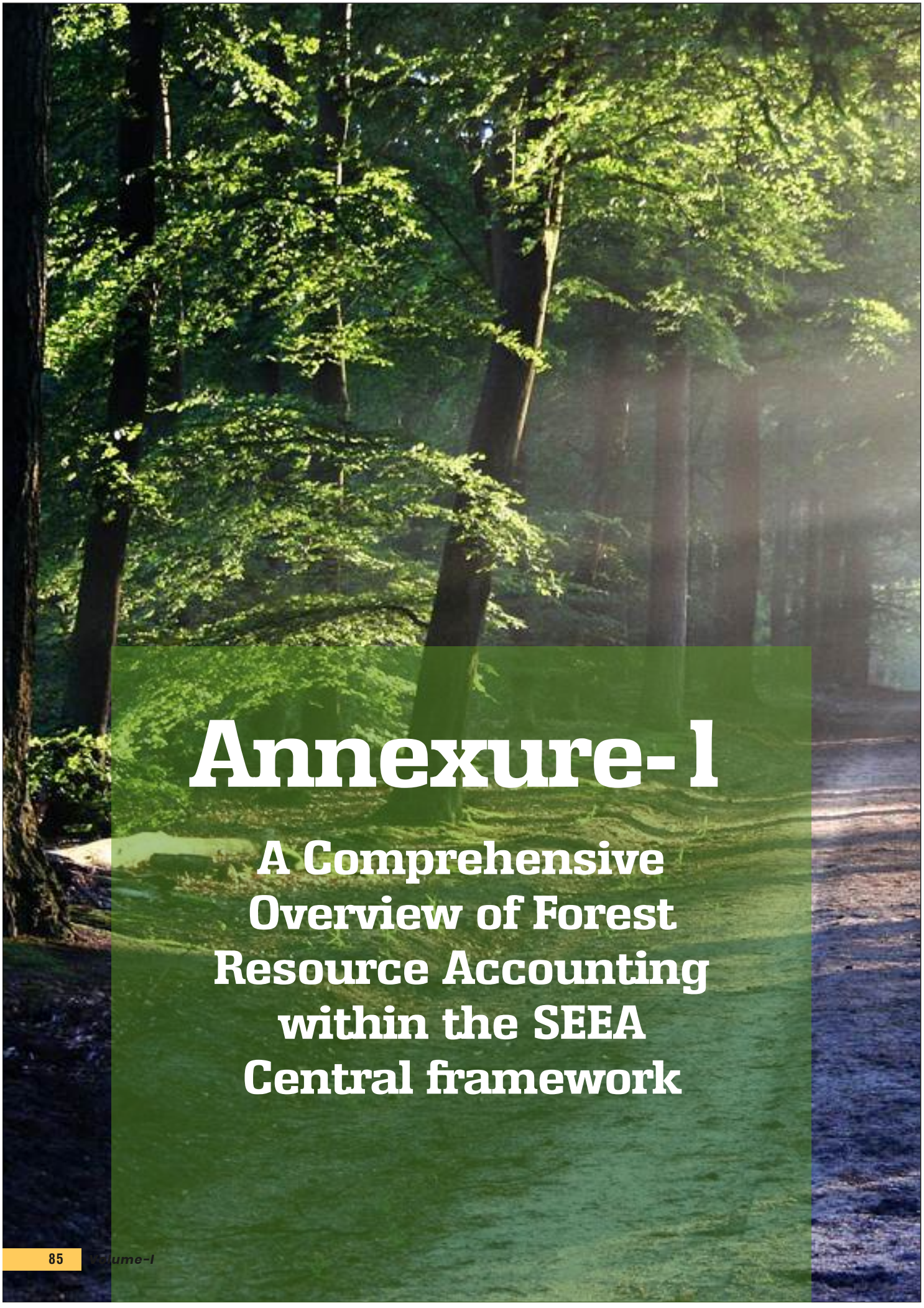
Forest Ecosystem Services		
Provisioning Services	• Timber provisioning (Monetary Asset) • Non-timber forest resources service (Firewood+ NTFP) (Monetary asset)	• Timber stock (Physical Asset)[36] • NTFP quantity (Physical Account)[36] • Fodder[39]
Regulating Services	• Carbon Retention service (Monetary asset)	• Carbon Local Climate Regulation and air filteration[36,39] • Soil Erosion Prevention (Physical and Monetary asset)[35,36,39] • Genetic diversity[38,39] • Pollination[39]
Cultural Services	• Eco-tourism (Physical and monetary account)	
Thematic Biodiversity, Water, Carbon and Land Accounts		• Organic matter content[37] • water quality[37,39] • Net carbon Balance[37]
SEEA-CF Asset Account	• Opening/closing stock, additions, reductions [VDF, MDF, OF (ha), Scrub, Non-Forest]	

*Based on literature review; # The list of indicators and references presented herein is not exhaustive and may be further expanded. The references cited in this table identify these indicators and, in certain instances, offer detailed methodologies for their assessment.

[35]WAVES Himachal Report (Technical Rept WAVES Himachal 5-29-15 web.pdf) – World Bank, Himachal Forest Dept.
[36]NCAVES India Report (ncaves_india_report_jan21161121016053016123729854 51.pdf) – MoSPI, NCAVES Project
[37]India Assessment 2019 (india_assessment_2019.pdf) – MoSPI National SEEA-EA Assessment.
[38]https://www.mospi.gov.in/sites/default/files/publication_reports/Green_National_Accouts_in_India_1may13.pdf
[39]https://wgbis.ces.iisc.ac.in/energy/NCAVES/IISc_Ecosystemservices_2JUNE2022%5B2227%5D.pdf

At the state level, institutionalising forest accounting requires the adoption of SEEA-compliant templates for both physical and monetary valuation of forests. States should build upon their forest working plans and build capacity of respective departments for compiling forest accounts as per SEEA framework. States as well should focus on developing a phased roadmap to mainstream forest ecosystem accounting by establishing regular forest extent, condition, and ecosystem service assessments, underpinned by robust GIS–MIS platforms for real-time data integration and public reporting. Enhancing institutional capacity through regular training and reporting, and integrating forest asset accounts into State Economic Surveys, will support evidence-based policy decisions. States are also encouraged to align their forest data with national Supply and Use frameworks, enabling the inclusion of forest services in broader economic assessments and supporting initiatives for valuation of forest asset.

India is well-positioned to lead in integrating environmental values into economic policy through the SEEA framework, with a focus on forest ecosystems. By strengthening institutions, improving data infrastructure, and mainstreaming valuation methods, forest accounting can become a powerful tool for sustainable development. Embedding these accounts into laws, budgets, and planning documents will ensure long-term ecological and economic gains. Continued investment in capacity-building and innovation will be essential. With coordinated efforts, India can align its forest governance with climate and biodiversity goals, securing benefits for both nature and people.



Annexure-I

A Comprehensive Overview of Forest Resource Accounting within the SEEA Central framework

KEY MESSAGES

- The **SEEA Central Framework** is a multipurpose system designed to describe interactions between the economy and the environment, as well as to measure stocks and changes in environmental assets. The Framework measures (a) physical flows of materials and energy, (b) stocks and changes of environmental assets, and (c) economic activities related to the environment. These are translated into Supply and Use tables, Asset accounts for individual environmental asset and Functional accounts in physical and monetary terms, with well-defined boundaries to ensure consistency over time and between countries.

- **Physical asset accounts** describe how to measure and record the physical stocks and changes of forests and other wooded land. It details the classification, boundaries, and types of changes (such as natural growth, removals, or losses) necessary for comprehensive forest asset accounting and specifically for timber resources as well.

- The **Monetary Supply and Use Tables (MSUT) and Physical Supply and Use Tables (PSUT)** are key tools in the SEEA for recording the flows of products and natural inputs within the economy and between the economy and the environment. While MSUTs record these flows in monetary terms, PSUTs capture them in physical units.

- This is an international framework which can be modified in national context as per availability of indicators and data.

SEEA Central Framework[40]

This chapter is based on the report of UN's **System of Environmental-Economic Accounting Central Framework (SEEA CF)**, which is an international standard for integrating environmental information-like natural resources-with economic data. SEEA CF helps track how resources such as forests contribute to the economy and how they change over time. For our report, we have focused specifically on the **forest-related components** of this framework. It explains how to record and monitor changes in forest resources-like forest area and timber in **physical terms** (such as hectares or cubic meters) and **monetary terms** (like rupees). These changes include natural growth, harvesting, planting, and losses due to damage or land use change. This chapter provide the framework mentioned for compilation of forest accounting as per SEEA CF.

A1.1 The Central Framework organizes and integrates the information on the various stocks and flows of the economy and the environment in a series of tables and accounts. The Central Framework comprises the following types of tables and accounts:

(a) Supply and use tables in physical and monetary terms showing flow of natural inputs, products and residuals;

(b) Asset accounts for individual environmental assets in physical and monetary terms showing the stock of environmental assets at the beginning and the end of each accounting period and the changes in the stock;

(c) A sequence of economic accounts highlighting depletion-adjusted economic aggregates;

(d) Functional accounts recording transactions and other information about economic activities undertaken for environmental purposes. The analysis of these data can also be extended by linking the tables and accounts to relevant employment, demographic and social information.

[40]This chapter has been reproduced from the System of Environmental-Economic Accounting 2012—Central Framework (SEEA-CF), as provided in the official United Nations document (United Nations et al., 2014). The structure, definitions, and much of the explanatory content have been directly drawn from this source, with modifications to reflect the specific context of forest resources. For the original framework and a comprehensive account of the methodologies, please refer tohttps://seea.un.org/content/seea-central-framework.

A1.2 The strength of the Central Framework stems from its consistent application of definitions and classifications for stocks, flows and economic units across different types of environmental assets and different environmental dimensions (e.g., across water and energy). Additional strength is derived from the consistent application of these various definitions and classifications in physical and monetary terms, as well as from their consistency with the same definition and classifications used in the SNA and economic statistics. Readers are encouraged to refer to chapter 1 of the 2014 SEEA-CF[41].

Accounting rules and principles

A1.3 The recording of accounting entries requires the use of a consistent set of accounting rules and principles. Without them, related transactions and flows may be recorded on different bases, at different times and with different values, thus making accounting and reconciliation difficult and the information far less useful. The Central Framework follows the same accounting rules and principles as the SNA. The present section introduces the rules and principles of greatest relevance. Readers are encouraged to refer to chapter 2 of the 2014 SEEA-CF[41].

• Double- and quadruple-entry accounting: A key feature of accounting is the consistency that is applied in the recording of transactions between different economic units.

• Time of recording: One requirement of the double- and quadruple-entry accounting principles is that transactions and other flows must be recorded as occurring at the same point in time in the various accounts for both units involved.

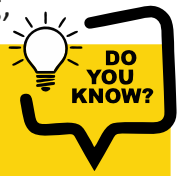
• Units of measurement accounting structure: For accounts compiled in monetary terms, all entries in the accounts must be measured in terms of money and therefore the components from which the entries are built up must be measured in terms of money. For accounts compiled in physical terms, the unit of measurement will vary depending on the type of asset concerned. A common principle is that within a single account in physical terms only one unit of measurement should be used so that aggregation and reconciliation is possible across all accounting entries.

[41]https://seea.un.org/sites/seea.un.org/files/seea_cf_final_en.pdf.

- Valuation at market prices: For accounts in monetary terms, the question of valuation is central. In the SEEA, as in the SNA, the values reflected in the accounts are, in principle, the current transaction values or market prices for the associated goods, services, labour or assets that are exchanged.

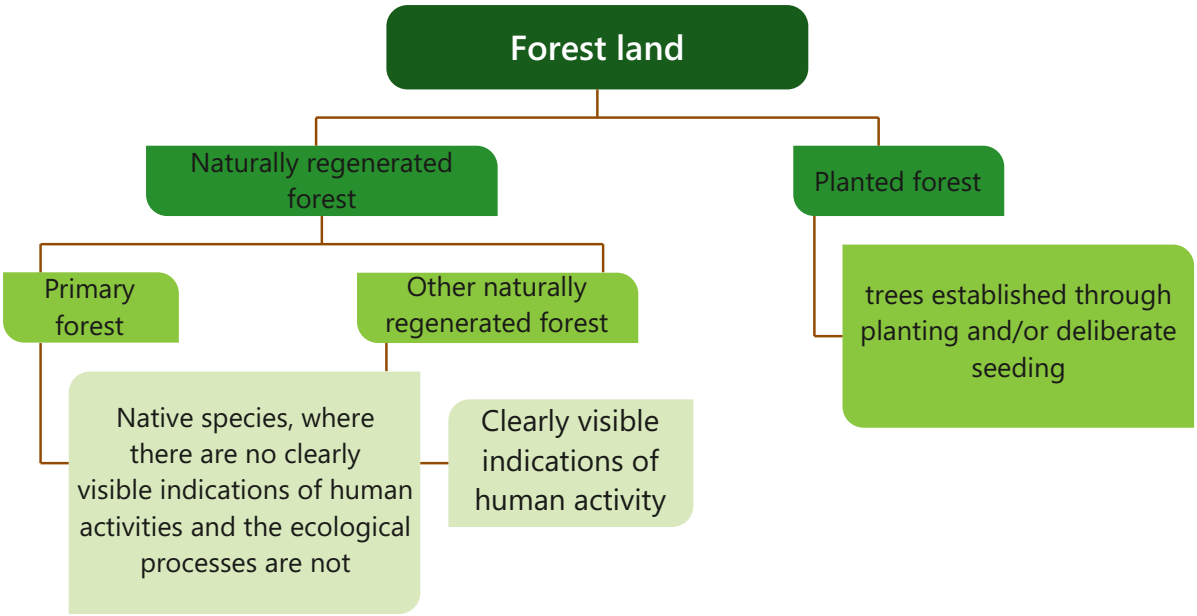
SEEA-CF: forest asset account-

A1.4 Environmental assets are the naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity. Although they are naturally occurring, many environmental assets are transformed to varying degrees by economic activities. In the SEEA, environmental assets are considered from two perspectives. In the Central Framework, the focus is on individual components of the environment that provide materials and space to all economic activities. Examples include mineral and energy resources, timber resources, water resources and land. In the SEEA-Central Framework, forests are classified primarily as a form of land cover, while forestry is identified as a category of land use. Although forests are often seen predominantly in terms of their timber resources, specifically, the volume of standing timber, it is important to recognize that forests support the production of wide range of products. Therefore, forests and timber resources should not be regarded as interchangeable. Furthermore, timber resources are not exclusively confined to forested areas; in many countries, other land cover types, such as other wooded lands, also contain timber resources. In light of these distinctions and the Central Framework's emphasis on a resource-based perspective for environmental assets, forests are incorporated as a subcategory under land, with timber resources on these lands recognized as a distinct category of environmental asset.



The SEEA Central Framework brings together, in a single measurement system, information on water, minerals, energy, timber, fish, soil, land and ecosystems, pollution and waste, etc. The SEEA Central Framework is made up of a number of different accounts, all of which are integrated and which draw information together into one coherent system.

Scope of the forest and other wooded land account



A physical asset account of forest and other wooded land (hectares)

A1.5 A physical asset account for forests is presented in below table. It shows the opening and closing stock by area and changes in the area of forest and other wooded land. The area of forest and other wooded land should be measured inclusive of relevant access roads, rivers and streams.

- **Afforestation** represents an increase in the stock of forest and other wooded land either due to the establishment of new forest on land that was previously not classified as forest land, or as a result of silvicultural measures such as planting and seeding. In particular, land previously classified as other wooded land may be converted to forest land as a result of silvicultural measures.

- **Natural expansion** is an increase in area resulting from natural seeding, sprouting, suckering or layering. Where the expansion is into the area of another type of forest or other wooded land (e.g., natural expansion of other naturally regenerated forest into other wooded land), a corresponding entry for natural regression should be recorded.

- **Deforestation** represents a decrease in the stock of forest and other wooded land due to the complete loss of tree cover and transfer of forest land to other uses (e.g., use as agricultural land, land under buildings or roads) or to no identifiable use. Removals of standing timber do not lead to decreases in forest and other wooded land if the use of the land does not change after felling.

- **Natural regression** should be recorded when the stock of forest and other wooded land reduces for natural reasons. An entry for natural regression should be recorded together with an entry for natural expansion when there are natural changes in the areas of different types of forest and other wooded land (e.g., natural expansion of other naturally regenerated forest into other wooded land-i.e., a natural regression of other wooded land).

Table A1.1: Sample table for physical asset account for forest and other wooded land

	Total of forest and other wooded land				
	Primary forest	Other naturally regenerated forest	Planted forest	Other wooded land	Total
Opening stock of forest and other wooded land					
Additions to stock					
-Afforestation					
-Natural expansion					
Total additions to stock					
-Reductions in stock					
-Deforestation					
Natural regression					
Total reductions in stock					
Closing stock of forest and other wooded land					

Monetary asset account for forest and other wooded land (currency units)

A1.6 Generally monetary asset accounts for forest and other wooded land are not separately described but are covered as part of the monetary asset accounts for land use.

Table A1.2: Sample table for monetary asset account for different type of land use

	Type of Land Use								
	Agriculture	Forestry	Land use for aquaculture	Use of built-up and related areas	Land used for maintenance and restoration of environmental functions	Other uses of land n.e.c	Land not in use	Inland water	Total
Opening value of stock of land									
Additions to stock									
Acquisitions of land									
Reclassifications									
Total additions to stock									
Reductions in stock									
Disposals of land									
Reclassifications									
Total reductions in stock									
Revaluations									
Closing value of stock of land									

Physical asset accounts for timber resources

A1.7 The physical asset account for timber resources records the volume of timber resources at the beginning and end of an accounting period and the change in this stock over the accounting period of particular interest is the analysis of the natural growth of timber resources compared with the removals. A basic structure for a physical asset account for timber resources is presented in below table-

Table A1.3: Framework for Physical Asset Account for Forest Resource: Timber

	Type of timber resource		
	Cultivated timber resources	Natural timber resources	
		Available for wood supply	Not available for wood supply
Opening stock of timber resources			
Additions to stock			
Natural growth			
Reclassifications			
Total additions to stock			
Reductions in stock			
Removals			
Felling residues			
Natural losses			
Catastrophic losses			
Reclassifications			
Total reductions in stock			
Closing stock of timber resources			
Supplementary information			
Fellings			

A1.8 The asset account should distinguish between the types of timber resource, most importantly between cultivated timber resources and natural timber resources. For natural timber resources, a distinction should be made between those timber resources available for wood supply and those not available for wood supply, so as to ensure that the different scopes of the asset accounts in physical and monetary terms can be reconciled. Depending on the purpose of analysis and available data, accounts by species of tree may be compiled.

Additions to the stock

- The stock of timber resources will increase due to natural growth. This is measured in terms of the gross annual increment, i.e., the volume of increment over the reference period of all trees with no minimum diameter.
- Increases in the area of forest land, other wooded land and other areas of land that lead to increases in the volume of available timber resources should, be recorded as reclassifications. Reclassifications may also occur as a result of changes in management practice that shift timber resources from cultivated to natural or vice versa.

Reductions in the stock

- The stock of timber resources will decrease over an accounting period through the removal of timber resources and natural losses. Removals are estimated as the volume of timber resources removed from forest land, other wooded land and other land areas during the accounting period. They include removals of trees felled in earlier periods and the removal of trees killed or damaged by natural causes. Removals may be recorded by type of product (e.g., industrial roundwood or fuelwood) or by species of tree (e.g., coniferous or broadleaved).
- Felling residues are associated with the fact that, at the time of felling, a certain volume of timber resources is rotten, damaged or in excess in terms of the size requirements. Felling residues exclude small branches and other parts of the tree that are also excluded from the scope of timber resources. Estimates of felling residues may also provide important information on the nature of forestry practice.

- **Natural losses** are the losses to the growing stock (i.e., living, standing trees) during an accounting period due to mortality from causes other than felling. Examples include losses due to natural mortality, insect attack, fire, wind throw or other physical damages. Natural losses should include only those losses that can be reasonably expected when considering the timber resources as a whole.
- **Catastrophic losses** should be recorded when there are exceptional and significant losses of timber resources due to natural causes. Catastrophic losses should be recorded only when there is no possibility that the timber resource can be removed.
- **Fellings:** Annual fellings are equal to the volume of timber resources that is felled during an accounting period. Fellings include silvicultural and pre-commercial thinning and cleanings. Where available, estimates of the volume of fellings may be added as supplementary information in the physical asset account.

Monetary asset accounts for timber resources

- Monetary asset accounts for timber resources consist in measuring the value of the opening and closing stock of timber resources and the changes in the value of the stock over an accounting period. The monetary asset account for timber resources is presented in below table. Most of the changes in the stock relate directly to changes recorded in the physical asset account; but there are also entries relating to the revaluation of timber resources, which are recorded when the prices for timber change during an accounting period.
- It may be that not all timber resources are available for harvest because of forest legislation and/or for environmental and economic reasons. It is recommended that the volume of timber resources that cannot be harvested be separately identified and not form a part of the overall calculations of the value of timber resources.
- Estimates are made for the value of natural growth and the value of removals. For Cultivated timber resources, the natural growth are considered an increase in inventories and the removal of trees is treated as a decrease in inventories. Following the SNA, only the change in inventories would normally be recorded, but the entries are recorded on a gross basis in the SEEA.
- For natural timber resources, the natural growth is not considered an increase in Inventories, since the growth in the trees are not considered to be part of a production process. The removal of the timber resources represents the point at which the timber resources enter the economy and output is recorded at that point.

Table A1.4: Monetary asset account for timber resources (currency units)

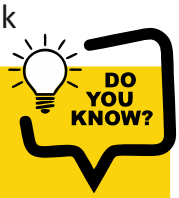
	Type of timber resource		
	Cultivated timber resources	Natural timber resources (Available for wood supply	Total
Opening stock of timber resources			
Additions to stock			
Natural growth			
Reclassifications			
Total additions to stock			
Reductions in stock			
Removals			
Felling residues			
Natural losses			
Catastrophic losses			
Reclassifications			
Total reductions in stock			
Revaluations			
Closing stock of timber resources			

Valuing the stock of timber resources

A1.9 Resource rent on timber resources can be derived as the gross operating surplus from the harvest of timber resources (after taking into account specific taxes and subsidies) less the value of the user costs of produced assets used in the harvesting process. Defined in this way, the resource rent will implicitly include a share that should be attributed to the land on which the timber stands. Resource rent can be estimated more directly by using estimates of the stumpage price, which is the amount paid per cubic metre of timber by the harvester to the owner of the timber resources. Where timber resources are sold prior to felling, relevant contract prices may also be used, with appropriate adjustments for the scope and coverage of the prices to align them with the concept of resource rent.

Valuation of removals, natural growth, depletion and other flows

- In general terms, the valuation of flows of timber resources (including removals, natural growth, depletion and other flows) should be undertaken using the same in situ resource prices underlying the valuation of the opening and closing stock of timber resources. With respect to catastrophic losses, for example, due to wind throw or forest fire, when a catastrophic event does not fully destroy the wood, it is necessary to take into account the value of the wood that will be salvaged. Prices may rise following destruction of timber resources due to fire or they may fall if trees are killed but not destroyed in storms. The price changes will reflect the changes in the pattern of timber available to be supplied. Further, the stumpage value of the salvaged timber has to be accounted for in the value of the stock for the period until its removal from the forest, which, in some cases, may take a number of years.



SEEA accounts are designed to facilitate evidence-based policy, performance monitoring, and international environmental reporting, directly supporting India's obligations under agreements like the SDGs, UNFCCC, and CBD

- Other changes that affect the value of stocks of standing timber as a resource for the logging industry are changes in use or status, for example, when forests are protected and logging is prohibited. In this case, the value of the standing timber, in terms of income from the sale of timber resources, is reduced to zero.

Integration of supply and use tables in physical and monetary terms

A1.10 The integration of supply and use tables in physical and monetary terms centres on the use of common classifications and terminology for the measurement of flows of products and the use of common boundaries between the economy and the environment. Consequently, flows recorded in monetary terms that focus on the exchanges of products between economic units are, in broad terms, the same set of flows of products measured in physical terms. Physical flows of natural input and residuals are not available in monetary terms but, since the measurement boundaries for these flows are aligned with measurement boundaries for product flows, the addition of natural input and residual flows in the supply and use table framework does not compromise the recording of flows relating to products.

A1.11 The alignment of supply and use tables in physical and monetary terms is shown in below table. The key areas of integration are the use of the same classifications for industries and products and the use of common groupings of economic units: enterprises (represented by industries), households and the rest of the world.

Table A1.5: Supply and Use Tables in physical and monetary terms

Supply table in monetary terms						
	Production (including household production on own account) Industries – classified by ISIC				Flows from the rest of the world	Total
Products	Output				Imports	
Total						
Use table in monetary terms						
	Intermediate consumption	Final consumption				
	Industries – classified by ISIC	Households	Government	Accumulation	Flows to the rest of the world	Total
Products	Intermediate consumption	Household final consumption expenditure	Government final consumption expenditure	Gross capital formation	Exports	
Total						
\	**Supply table in physical terms**					
	Production; Generation of residuals					

	Industries (including household production and own account) – classified by ISIC	Generation of residuals by households		Accumulation	Flows from the rest of the world	Flows from the Environment	Total
Natural inputs						Flows from the environment	
Products	Output				Imports		
Residuals	Residuals generated by industry	Residuals generated by household final consumption		Residuals from scrapping and demolition of produced assets Emissions from controlled landfill sites	Residuals received from rest of the world	Residuals recovered from the environment	
Total							

Use table in physical terms

	Intermediate consumption ; use of natural inputs, collection of residuals	Final consumption					
	Industry – classified by ISIC			Accumulation	Flows to the rest of the world	Flows to the environment	Total
Natural inputs	Extractions of natural inputs						
Products	Intermediate consumption	Household final consumption		Gross capital formation	Exports		
Residuals	Collection and treatment of residuals			Accumulation of waste in controlled landfill sites	Residuals sent to the rest of the world	Residual flows to the environment	
Total							

Note: Dark grey cells are null by definition

Integration of asset accounts and supply and use tables

A1.12 The integration of information from asset accounts and supply and use tables is of particular relevance in the analysis of natural resources. For example, the assessment of the stock of fish resources will focus not only on extractions of fish relative to the available stock but also on the relationship between the extraction and other flows. Thus, there will be interest in so-called forward linkages which consider the extraction of fish in relation to the supply and use of fish products in the economy and associated international trade in fish products. Moreover, there will be interest in backward linkages for understanding the production processes associated with cultivated or natural fish resources, investment in boats and fishing gear by the fishing operators, and the extent of expenditure on resource management associated with fisheries. The integration of data from asset accounts and supply and use tables can provide information needed to examine these types of linkages. Similar considerations are relevant in the analysis of other natural resources.

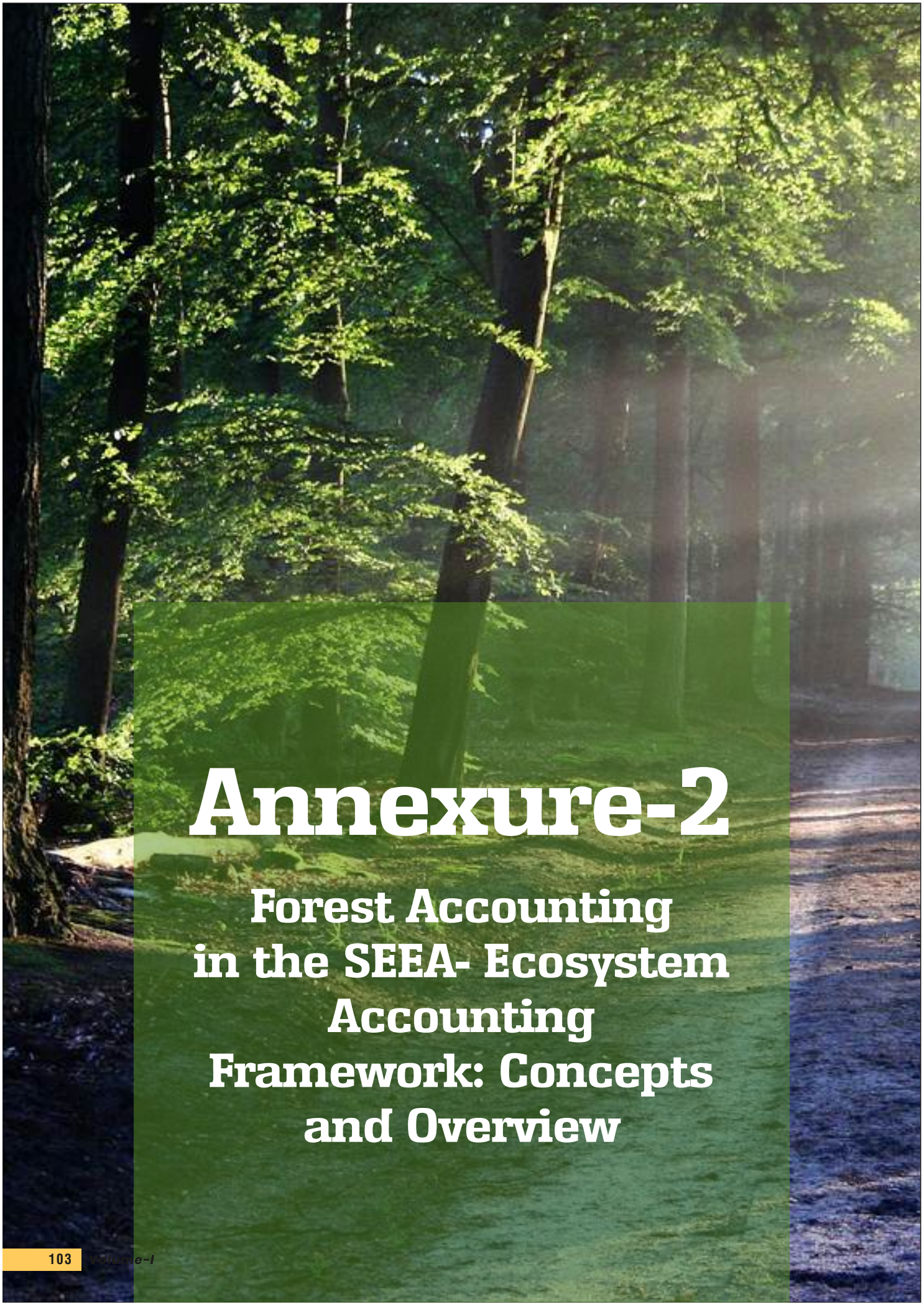
A1.13 Asset accounts present information on the stock of environmental assets at the beginning and end of an accounting period and on the changes in the stock over the period. The changes may be of many types. They may be due to economic activity (e.g., extraction of natural resources) or to natural flows (e.g., losses of environmental assets following natural disasters).

A1.14 The relationship between these flows and the flows recorded in the supply and use tables is shown in below table. Changes due to economic activity are recorded consistently in both the asset accounts and the supply and use tables, since extraction represents both a reduction in stock (an asset account entry) and a use of natural inputs (an entry in the physical supply and use table). For environmental assets, this consistency is ensured by defining individual natural resources for the purposes of asset accounting in the same way as natural resource inputs in the physical supply and use table.

Table A1.6: Connections between supply and use tables and asset accounts

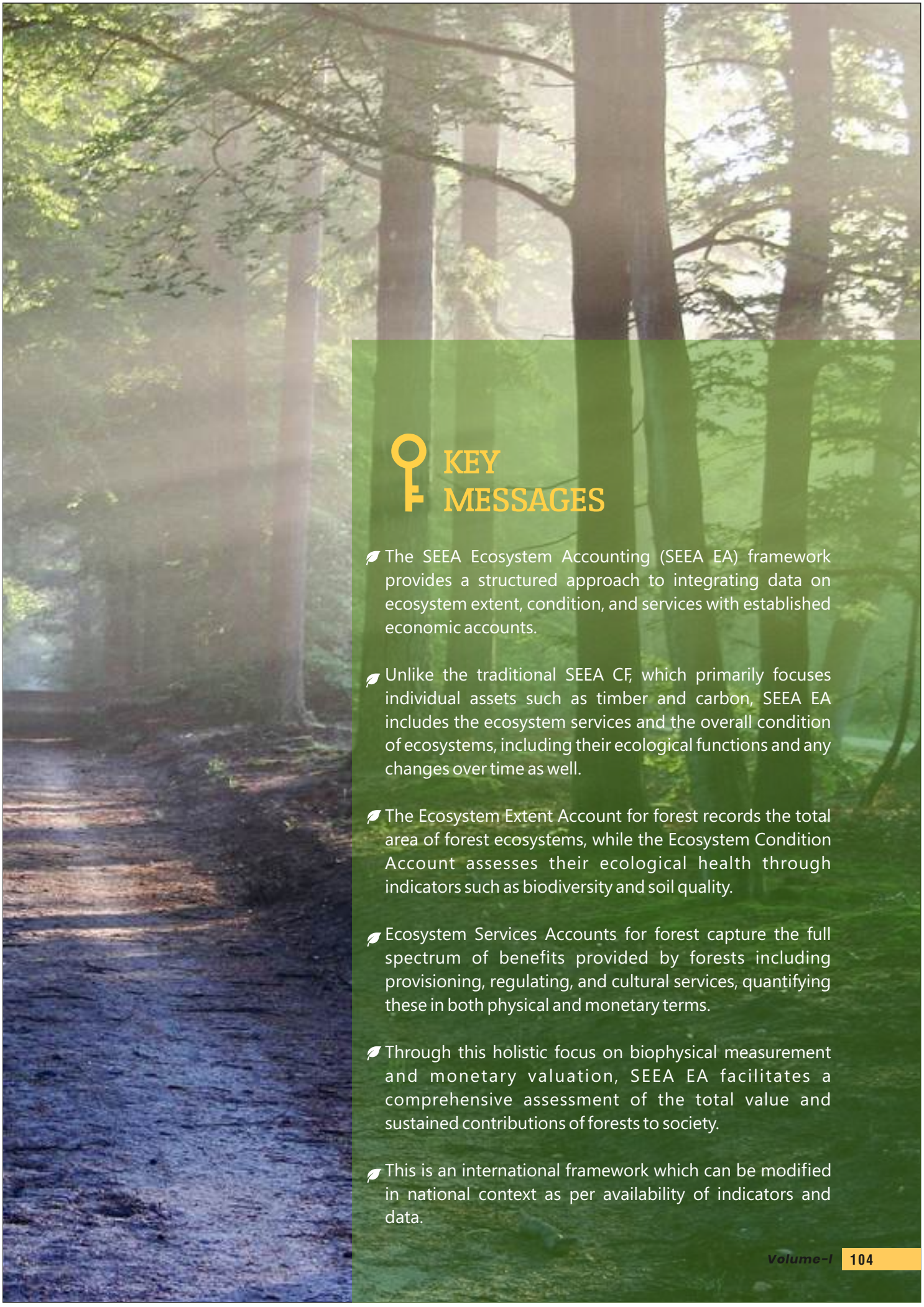
Asset accounts (Physical and monetaryterms)							
		Industries	**Households**	**Government**	**Rest of the world**	**Produced assets**	**Environmental assets**
							Opening stock
Monetary supply and use table	Product supply	Output			Imports		
	Product - use	Intermediate consumption	Household final consumption expenditure	Government final consumption expenditure	Exports	Gross Capital	
Physical supply and use table	Natural Inputs supply						Extracted natural resources
	Natural inputs use	Inputs of natural resources					
	Product supply	Output			Imports		
	Product use	Intermediate consumption	Households' final consumption		Exports	Gross capital formation	
	Residuals supply	Residuals generatedby industry	Residuals generatedby households' final consumption		Residuals received from the rest of the world	Residuals from scrapping and denotation of produced assets; emissions from controlled landfills	
	Residuals use	Collection and treatment of waste and other residuals			Residuals sent to the rest of the world	Accumulation of waste in controlled landfills	Residuals flowing to the environment
						Other changes in volume of assets (e.g. natural growth, discoveries catastrophic losses)	
						Revaluations	
						Closing stock	

Note: Dark grey cells are null by definition. Blank cells may contain relevant flows



Annexure-2

Forest Accounting in the SEEA- Ecosystem Accounting Framework: Concepts and Overview



KEY MESSAGES

- The SEEA Ecosystem Accounting (SEEA EA) framework provides a structured approach to integrating data on ecosystem extent, condition, and services with established economic accounts.
- Unlike the traditional SEEA CF, which primarily focuses individual assets such as timber and carbon, SEEA EA includes the ecosystem services and the overall condition of ecosystems, including their ecological functions and any changes over time as well.
- The Ecosystem Extent Account for forest records the total area of forest ecosystems, while the Ecosystem Condition Account assesses their ecological health through indicators such as biodiversity and soil quality.
- Ecosystem Services Accounts for forest capture the full spectrum of benefits provided by forests including provisioning, regulating, and cultural services, quantifying these in both physical and monetary terms.
- Through this holistic focus on biophysical measurement and monetary valuation, SEEA EA facilitates a comprehensive assessment of the total value and sustained contributions of forests to society.
- This is an international framework which can be modified in national context as per availability of indicators and data.

SEEA Ecosystem Accounting (SEEA EA) and Forest[42]

This chapter is based on the report of **SEEA Ecosystem Accounting (SEEA-EA)** framework, a global approach developed by the UN to measure how ecosystems-like forests-contribute to human well-being and the economy. Unlike the **SEEA Central Framework (SEEA-CF),** which focuses on individual natural resources (like timber or minerals) in terms of their quantity and monetary value, **SEEA-EA looks at the ecosystem as a whole**, including the condition of the environment and the services it provides. For our report, we have identified and refined the forest-related elements of the SEEA-EA report and provided sample framework for ecosystem accounting focused specifically on forests, which includes tracking changes in forest area, natural regeneration, deforestation, and the condition of forest ecosystems. This framework supports better integration of forest health and ecosystem services.

A2.1 Ecosystems are a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit. Examples are terrestrial ecosystems (e.g., forests and wetlands) and marine ecosystems. Often, there are interactions between different ecosystems at local and global levels.

A2.2 Ecosystems contribute to the generation of a variety of goods and services upon which people depend. These contributions are known as ecosystem services. Single ecosystems will usually generate a number of different ecosystem services. In general terms, the capacity of an ecosystem to provide services depends on the area covered (its extent) and the condition (its quality). This capacity is modified both positively and negatively through human behaviour. Commonly, through land-use conversion (e.g., conversion of forests to cropland), certain types of ecosystems are modified or replaced, which leads to the supply of a different basket of ecosystem services.

A2.3 SEEA Ecosystem Accounting has a distinct perspective on the measurement of environmental assets. In both the SEEA Central Framework and SEEA Ecosystem Accounting, environmental assets are defined broadly as “the naturally occurring living and non-living components of the Earth, together constituting the biophysical

[42]This chapter has been reproduced from the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA EA), as provided in the official United Nations document (United Nations et al., 2024). The structure, definitions, and substantial portions of the explanatory content have been directly drawn from this authoritative source, with select modifications to contextualize the material for specific applications or to address forest ecosystem considerations. For the original framework and comprehensive methodological guidance, please refer tohttps://seea.un.org/ecosystem-accounting

environment, which may provide benefits to humanity". However, for measurement purposes, environmental assets are considered from two complementary perspectives. In the SEEA Central Framework, the perspective for measurement purposes is on "individual" environmental assets, such as timber resources, land, mineral and energy resources, and water resources

A2.4 In contrast, in SEEA Ecosystem Accounting, the perspective is on ecosystems. This approach assesses how different individual environmental assets interact as part of natural processes within a spatial area to provide a range of services for economic and other human activity. Ecosystem assets are thus environmental assets as viewed from a systems perspective.

A2.5 Since not all individual environmental assets function within ecosystems, notably mineral and energy resources, a complete accounting for environmental assets requires both the SEEA Central Framework and SEEA Ecosystem Accounting.

A2.6 Ecosystem condition reflects the overall quality of an ecosystem asset in terms of its characteristics. The assessment of ecosystem condition involves two distinct stages of measurement with reference to both the quantity and the quality aspects of the characteristics of the ecosystem asset. In the first stage, it is necessary to select appropriate characteristics and associated indicators of changes in those characteristics. The selection of characteristics and Principles of ecosystem accounting associated indicators should be carried out on a scientific basis so that there is an assessment of the ongoing functioning, resilience and integrity of the ecosystem asset. Thus, movements of the indicators should be responsive to changes in the functioning and integrity of the ecosystem as a whole.

A2.7 Ecosystem extent refers to the size of an ecosystem asset. For ecosystem assets, the concept of extent is generally measured in terms of surface area, for example, hectares of a land-cover type. Where there is a mix of land covers within an ecosystem asset (e.g., a river basin or a mixed agricultural landscape), ecosystem extent may be reflected in the proportion of different types of land cover. Changes in the proportions of different land covers within a defined spatial area may be important indicators of changes in ecosystem assets.

A2.8 For a given ecosystem or group of ecosystems, ecosystem accounting considers the capacity of living components within their non-living environment to work together to generate flows known as ecosystem services. Ecosystem services are the contributions of ecosystems to benefits used in economic and other human activity. Ecosystem services, which are supplied in many ways and vary from ecosystem to ecosystem, may be divided into three groups:

(a) Provisioning services: It represent the material and energy contributions generated by or in an ecosystem, for example, provision of timber from forests, fishes or plants with pharmaceutical properties.

(b) Regulating services: It results from the capacity of ecosystems to regulate climate, hydrologic and biochemical cycles, Earth surface processes and a variety of biological processes. These services often have an important spatial aspect. For instance, the flood control service of an upper watershed forest is relevant only in the flood zone downstream of the forest, service provided by forest when they act as a sink for carbon;

(c) Cultural services: Cultural services, which are generated from the physical settings, locations or situations that give rise to intellectual and symbolic benefits obtained by people from ecosystems through recreation, knowledge development, relaxation and spiritual reflection. This may involve actual visits to an area, enjoying the ecosystem indirectly (e.g., through nature movies) or the satisfaction gained from knowing that an ecosystem containing important biodiversity or cultural monuments will be preserved.

A2.9 Generally, provisioning services are related to the material benefits of environmental assets, whereas the other types of ecosystem services are related to the non-material benefits of environmental assets.

A2.10 Length of the accounting period and frequency of accounts: In economic accounting, there are clear standards concerning the time at which transactions and other flows should be recorded and the length of the accounting period. The standard accounting period in economic accounts is one year. This length of time satisfies many analytical requirements although, often, quarterly accounts are also compiled.

A2.11 Time of recording: The general national accounting requirement is that transactions and other flows must be recorded as occurring at the same point in time in the various accounts for both units involved. In respect of ecosystem services, this implies that the supply of ecosystem services must be recorded in the same accounting period as that in which the use of those services is recorded. It is to be noted that the timing of the transaction may be different from timing with respect to when an ultimate benefit is received.

A2.12 Measures of ecosystem assets should be related to the opening and closing dates of the accounting period. If information available for the purposes of compiling accounts for ecosystem assets does not pertain directly to those dates, then adjustments to the available data may be required and in making such adjustments, an understanding of relevant shorter seasonal and longer natural cycles would be required.

A2.13 Units of measurement: In the measurement of stocks, entries relate to a measurement unit (e.g. total area or total volume) at a point in time. In the measurement of flows, entries relate to a measurement unit per unit of time (e.g. cubic metres per year). The unit of time that is appropriate will depend on the selected length of the accounting period.

- For accounts compiled in monetary terms, all entries in the accounts must be measured in currency units.

- For accounts compiled in physical terms, the units of measurement will vary and will depend on the account and the relevant variable.

- In ecosystem condition accounts, the use of different measurement units for each characteristic and associated variable is likely. Through normalization using reference levels and reference conditions, the variables can be compared with each other.

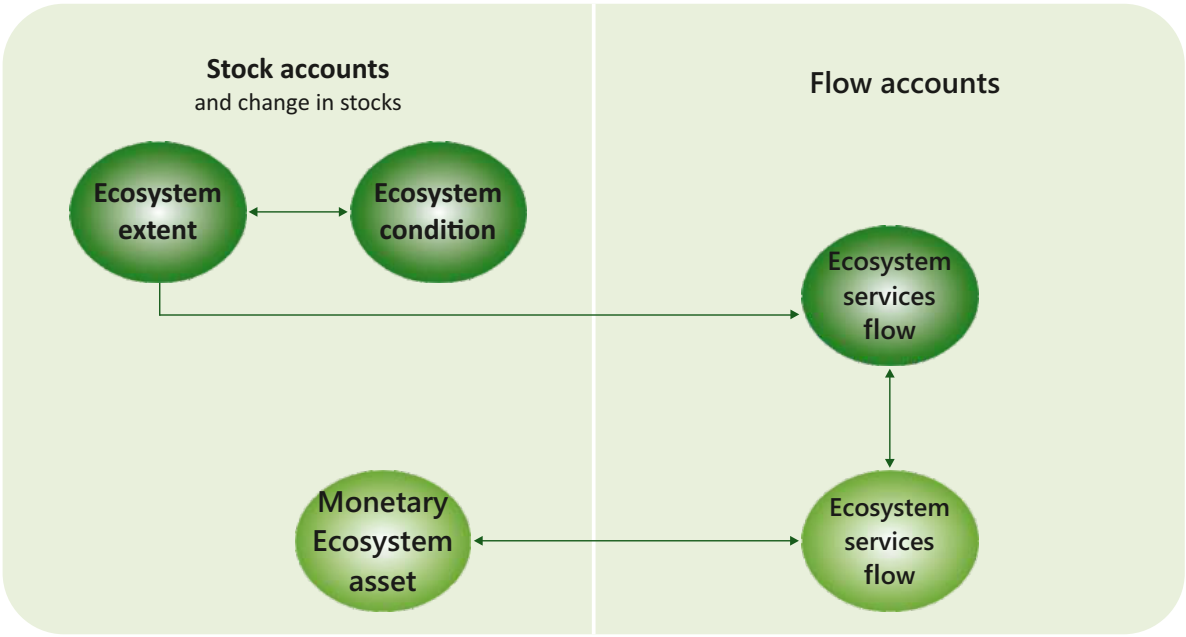
- In ecosystem services flow accounts in physical terms, different ecosystem services are recorded in different measurement units. Given the structure of these flow accounts, it is possible to aggregate across columns for a single service to provide an estimate of total supply or total use of that service. However, it is not possible to aggregate across different ecosystem services, that is over rows, to present total supply or use of ecosystem services for an ecosystem type or type of economic unit. Depending on the analytical purpose, this would be one motivation for the use of a standard money metric.

- In measuring supply and use, it is fundamental that the same measurement unit be applied for both supply and use of a single ecosystem service in physical terms. Thus, if the supply of a service is measured in tons per year, then the use of that service must also be measured in tons per year. This permits the balancing of supply and use for individual ecosystem services and the related reconciliation.

A2.14 the five accounts within the SEEA Ecosystem accounting system which are strongly interconnected and provide a comprehensive and coherent view of ecosystems. There is no single, all-encompassing ecosystem account, and, while SEEA EA has been designed as a system of integrated accounts, each account has merit in its own right and is a source of valuable information. In SEEA EA, ecosystem type reference classification based on IUCN GET. Forest Area is covered under 'Terrestrial' realm, and T1 (Tropical-subtropical forests), T2(Temperate-boreal forests & woodlands) and T3(Shrublands & shrubby woodlands) Biome.

Ecosystem Accounts	
1	Ecosystem extent account-physical terms
2	Ecosystem condition account-physical terms
3	Ecosystem services flow account-physical terms
4	Ecosystem services flow account-monetary terms
5	Monetary ecosystem asset account-monetary terms

Connections between ecosystem accounts



AS EAA is the geographical territory for which an ecosystem account is compiled.

Table A2.1: ecosystem extent accounts (units of area)

Terrestrial											
	T1 Tropical-subtropical forests				T2 Temperate-boreal forests and woodlands				T3 Shrublands and shrubby woodlands		
	Tropical/subtropical lowland rainforests	Tropical/subtropical dry forests and scrubs	Tropical/subtropical mon-tane rainforests	Tropical health forests	Boreal and temperate mon-tane forests and woodlands	Deciduous temperate forests	...	temperate pyric sclerophyll forests and woodlands	Seasonally dry tropical shrublands	...	Young rocky pavements, lava flows and screes
	T1.1	T1.2	T1.3	T1.4	T2.1	T2.2	...	T2.6	T3.1	...	T3.4
Opening extent											
Additions to extent											
Managed expansion											
Unmanaged expansion											
Reduction in extent											
Managed reductions											
Unmanaged reductions											
Net change in extent											
Closing extent											

The present table provides an indicative structure with respect to the set of ecosystem types. Compilation requires the use of nationally selected ecosystem types.

A2.15 Relevant accounting entries are:

• Opening extent and closing extent, which represent the total area of ecosystem assets for a given ecosystem type at the beginning and end of an accounting period, generally one year

• Additions to extent, which represent increases in the area of an ecosystem type. Where possible, to support understanding of the nature of the additions and possible policy responses, additions to extent should be separated into managed expansions and unmanaged expansions. Specifically:

– Managed expansions represent an increase in the area of an ecosystem type due to direct human activity in the ecosystem, including the unplanned effects of such activity. Examples include the conversion of forests to cultivated land and land reclamation work in coastal areas. Human activity may also create new areas of more natural ecosystem types, for example, through the reforestation of cultivated areas.

– Unmanaged expansions represent an increase in area of an ecosystem type resulting from natural processes, including seeding, sprouting, suckering or layering. Unmanaged expansion can be influenced by human activity, for example, the expansion of deserts due to the effects of climate change, or can result from abandonment of land by people.

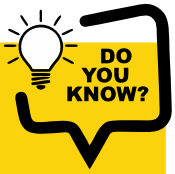
• Reductions in extent represent decreases in the area of an ecosystem type. Where possible, to support understanding of the nature of the reductions and possible policy responses, reductions in extent should be separated into managed reductions and unmanaged reductions. Specifically:

– Managed reductions represent a decrease in the area of an ecosystem type due to direct human activity in the ecosystem, including the unplanned effects of such activity, or cases where the activity may be illegal. Examples include deforestation and increase in urban areas.

– Unmanaged reductions represent a decrease in area of an ecosystem type associated with natural processes. Unmanaged reductions can be influenced by human activity, for example, the loss of coral reefs due to the effects of climate change, or can result from abandonment of land by people.

Ecosystem type change matrix

A2.16 Through use of spatially detailed data and by comparing maps from two periods to compile an ecosystem type change matrix, additional details on the nature of ecosystem conversions may be obtained. The ecosystem type change matrix set out in table shows the area of different ecosystem types at the beginning of the accounting period (opening extent); the increases and decreases in this area according to the ecosystem type it was converted from (in the case of increases) or the ecosystem type it was converted to (in the case of decreases); and, finally, the area covered by different ecosystem types at the end of the accounting period (closing extent). It is assumed here that the total area of the Ecosystem Accounting Area(EAA) is unchanged between the two points in time. Where the EAA has changed in size, a choice will need to be made regarding which point in time should be used to define the total area for comparison. The default option is to choose the EAA with the smaller area since only this EAA will include areas present in both time periods and will therefore provide complete data coverage for two points in time.



The SEEA EA is built on five core accounts i.e. ecosystem asset, ecosystem extent,services(physical and monetary), monetary asset account.These accounts are compiled using spatially explicit data and information about the functions of ecosystem assets and the ecosystem services they produce.

Table A2.2: Ecosystem type change matrix

Terrestrial														
					T1 Tropical-subtropical forests					T2 temperate -boreal forests and woodlands			T3	
					Tropical/subtropical lowland rainforest	….		Tropical health forests		Boreal and temperate montane forests and woodlands	…	Temperate pyric sclerophyll forests and woodlands	…	…
					T1.1	….		T1.4		T2.1	..	T2.6	..	…
Ecosystem types (based on the ecosystem functional group EFG level 3 of (UCN GET) Opening extent	Terrestrial	T1 Tropical-sub tropical forests	Tropical-subtropical lowland rainforests	T1.1										
			Tropical-subtropical dry forests and scrubs	T1.2										
			Tropical-subtropical montane rainforests	T1.3										
			Tropical health forests	T1.4										
		T2 Temperate-boreal forests and woodlands	Boreal and temperate high montane forests and woodlands	T2.1										
			Deciduous temperate forests	T2.2										
			…	…										
			Temperate pyric sclerophyll forests and woodlands	T2.6										
		T3	…	…										
			…	…										

Linking extent accounts and economic data

A2.17 There is a general ambition to link environmental data to measures of economic activity across all SEEA accounts. In the context of the ecosystem extent accounts, a primary means of achieving this aim is through linkage of data on ecosystem extent by ecosystem type with data on the economic owners or managers of the ecosystem assets. Data on economic owners may be categorized by institutional sector following the classes in the 2008 SNA such as non-financial corporations, general government and households. Such a classification is most relevant for understanding the owner ship and financing context. In some cases, there may be particular interest in identifying ecosystem areas (and the different ecosystem types) that are under common ownership or under the control of indigenous peoples.

A2.18 Below Table presents a cross-classification of ecosystem assets. The columns display data on ecosystem type and the rows display data on types of economic units for a single point in time, for example, the closing of the accounting period. The classes of economic units shown in the table reflect a production or management perspective and industrial categories are prominent. An alternative set of categories reflecting economic ownership by institutional sector (e.g. non-financial corporations, financial corporations, general government, households) may also be developed. Extent data classified by economic use and ownership should be maintained as distinct data layers and cross-tabulated or mapped when required

A2.19 The structural information on the links between ecosystem assets and economic units such as presented in below table also provides the basis for creating links between economic units and data from other ecosystem accounts, in particular ecosystem services flow accounts.

Table A2.3: Linking extent account and economic data for forest related ecosystem types

Terrestrial										
		T1 tropical -subtropical forests			T2 Temperate -boreal forests and woodlands			T3		
		Tropical/subtropicala and rain forests	…	Tropical health forests	Boreal and temperate montane forests and woodlands	…	Temperate pyric sclerophyll forests and woodlands	…	…	
		T1.1	T1.2	T1.4	T2.1	…	T2.6	…	…	**Total**
Closing extent by economic unit										
Agriculture, forestry and fishing	ISIC A									
Agriculture										
Forestry										
Fishing										
Mining and quarrying	ISIC B									
Manufacturing	ISIC C									
Electricity, gas, steam and air conditioning supply	ISIC D									
Water supply, sewerage, waste management and remediation activities	ISIC E									
Services										
Other industries										
Government										
Households										
Total										

Ecosystem condition variable account

A2.20 Ecosystem condition variables are quantitative metrics describing individual characteristics of an ecosystem asset. A single characteristic can have several associated variables, which may be complementary or overlapping. Variables differ from characteristics (even if the same descriptor is applied to them) since they are clearly and unambiguously defined (through measurement instructions, formulae, etc.) and are associated with well-defined units of measurement of quantity or quality. Examples of variables include number of bird species, tree coverage (percentage) and turbidity (measured in nephelometric turbidity units (NTUs)).

A2.21 Physical state characteristics (class A1) include the physical descriptors of the abiotic components of the ecosystem (soil, water, air).

A2.22 Chemical state characteristics (class A2) include descriptors of the chemical composition of the abiotic ecosystem components. This typically involves a focus on the accumulated stocks of pollutants or nutrients in soil, water or air.

A2.23 Compositional state characteristics (class B1) include a broad range of "typical" biodiversity characteristics that describe the composition of ecological communities from a biotic perspective.

A2.24 Structural state characteristics (class B2) include characteristics focused primarily on the vegetation and biomass of ecosystems that reflect the amount of local living and dead plant matter.

A2.25 Functional state characteristics (class B3) include characteristics related to relevant ecosystem processes (e.g. frequency, intensity) that are not already covered by other ECT classes. Information on the state of specific functional groups of species that perform ecosystem functions (e.g. producers, pollinators, nitrogen fixers, predators, decomposers) could be included here.

A2.26 Landscape and seascape characteristics (class C1) include characteristics of eco system assets that are quantifiable at larger (landscape, seascape) spatial scales but have an influence on the local condition of ecosystems and can be attributed to individual ecosystem assets.

A2.27 In the structure of the ecosystem condition variable account, opening and closing entries are recorded for selected variables for an ecosystem type. The variables are grouped based on the Ecosystem Condition Topology (ECT).

Table A2.4: Structure of the ecosystem condition variable account

SEEA Ecosystem condition Typology (ECT) class	Variables		Ecosystem type		
	Descriptor	Measurement unit	Opening value	Closing value	Change
Physical state	Variable 1				
	Variable 2				
Chemical state	Variable 3				
Compositional State	Variable 4				
	Variable 5				
Structural state	Variable 6				
Functional state	Variable 7				
Landscape/seascape characteristics	Variable 8				

A2.28 The structure of the ecosystem condition indicator account builds directly on the ecosystem condition variable account by relating each variable to a reference level. Each variable is rescaled to a uniform dimension less scale [0, 1] using the variable's reference level. The data in the indicator account allows descriptions of trends in condition to be interpreted relative to an agreed reference condition based on ecosystem integrity. This allows for statements concerning whether, for a given variable, ecosystem condition can be considered high (close to the reference level) or low (distant from the reference level). The indicator account can be used to monitor and report change in values over time.

Table A2.5: Structure of the ecosystem condition indicator account

SEEA Ecosystem Condition Typology (ECT) class	Indicators		Ecosystem type						
			Variables values		Reference level values		Indicator values (rescaled)		
	Descriptor	Measure-ment unit	Opening value	Closing value	Upper level (e.g. natural)	Lower level (e.g. collapse)	Opening value	Closing value	Change in indicator
Physical state	Variable 1								
	Variable 2								
Chemical state	Variable 3								
Compositional State	Variable 4								
	Variable 5								
Structural state	Variable 6								
Functional state	Variable 7								
Landscape/seascape characteristics	Variable 8								

Ecosystem condition indices

A2.29 The derivation of aggregate ecosystem condition indices is possible where there is interest in reporting on ecosystem condition at higher levels of aggregation than those presented in the ecosystem condition indicator account. The aggregation of ecosystem condition indicators aims towards generating summarized information from a large number of data points. This can be useful in communicating general trends.

A2.30 An ecosystem condition index is derived from a second aggregation step using the subindices for each ecosystem type ("mean values" approach). Table A2.7 presents the derivation of various condition indices using stylized indicator values.

A2.31 An alternative method for presenting data of the aggregate indices is to record the areas of each ecosystem type that is covered by various ranges of ecosystem condition relative to the reference condition. For example, an account for the ecosystem type forests could show the total area of forest divided into low, medium or high condition areas presented in table A2.6.

Table A2.6: Ecosystem condition indices reported using discretized ranges area (percentage) in each range of condition

SEEA ecosystem condition typology (ECT) class	Indicators		Ecosystem type					
	Descriptor	Indicator weight	Opening value			Closing value		
			High	Medium	Low	High	Medium	Low
Physical state	Indicator 1							
	Indicator 2							
	Subindex							
Chemical state	Variable 3							
Compositional State	Variable 4							
	Variable 5							
	Subindex							
Structural state	Variable 6							
Functional state	Variable 7							
Landscape/seascape characteristics	Variable 8							
Ecosystem condition index	**Index**							

Table A2.7: Ecosystem condition indices reported using rescaled indicator values (mean values approach)

SEEA Ecosystem Condition Typology (ECT) class	Indicators	Ecosystem type				
	Descriptor	Indicator value			Index value	
		Opening value	Closing value	Indicator weight	Opening value	Close Value
Physical state	Indicator 1					
	Indicator 2					
	Index					
Chemical state	Indicator 3					
Total abiotic characteristics						
Compositional State	Indicator 4					
	Indicator 5					
	Index					
Structural state	Indicator 6					
Functional state	Indicator 7					
Total biotic characteristics						
Landscape/seascape characteristics	Indicator 8					
Ecosystem condition index	**Index**					

Tables A2.6 and A2.7 present the derivation of ecosystem condition indices for one ecosystem type. For presentational purposes, it may be appropriate to summarize the results for a number of ecosystem types in one table

The table A2.8 provide exhaustive list of condition indicators which can be used for derivation of aggregate ecosystem condition indices. It outlines the specific indicators used to assess ecosystem condition for various forest ecosystem, following the SEEA-EA Ecosystem Condition Typology. Each biome, such as tropical/sub-tropical forests, temperate-boreal forests, and shrublands, is evaluated across six key condition classes: physical, chemical, compositional,

structural, functional, and landscape/seascape characteristics. For each class, relevant indicators are identified (e.g., soil water availability, species richness, canopy structure, dry matter productivity, landscape connectivity), tailored to the ecological features of the biome.

Table A2.8: Examples of condition variables for forest ecosystem

		A1 Physical state	A2 Chemical state	B1 Compositional state	B2 Structural state	B3 Functional state	C1 Landscape/seascape
T1	Tropical/sub-tropical forests	Soil water availability in the driest quarter; wetness	Soil organic carbon content; leaf and litter nitrogen concentration	Tree species richness; bird species richness	Tree cover density; dominant tree height; number of canopy layers; deadwood volume, forest age class distribution; density of epiphytes	Dry matter productivity; presence of seed dispersing species (capacity for regeneration); water stress index	Forest area density; landscape diversity; forest connectivity; ratio of edge distance to interior area of forest patches
T2	Temperate-boreal forests and woodlands biome	Vegetation water content (NDWL)	Soil organic carbon content; air pollutant concentration; follar and litter nitrogen concentration	Tree species richness; lichen species richness; bird species richness	Forest floor depth (soil layer thickness); tree cover density; deadwood volume; forest age class distribution	Dry matter productivity; density of tress with hollows for nesting; presence of top predator species (food web functionally); NDVI: water stress index	Forest area density; landscape diversity; forest connectivity;
T3	Shrublands and shrubby woodland	Percentage burned area; soil layer thickness	Soil organic carbon content; soil phosphorus concentration	Bird species richness	Tree Cover Density	Dry matter productivity; proportion of re-sprouting species after fire (capacity for regeneration)	Landscape diversity; shrubland/forest connectivity

Use of data on environmental pressures

A2.32 The measurement of environmental pressures is often considered an indirect approach to measuring ecosystem condition (European Commission, 2016). An environmental pressure is a human-induced process that alters the condition of ecosystems (Maes and others, 2018). An important type of environmental pressure is overharvesting, which can frequently be linked to environmental stocks (e.g. timber stocks in forests or fish stocks in marine

ecosystems). In this case, the associated ecosystem types can have a specific target ecosystem service (typically a provisioning service) and traditional ecosystem management is aimed at maximizing the flows of that service (de Groot and others, 2010). The intensity of these management activities has been shown to exert strong influences on the supply of a broad range of services, extending well beyond the original target ecosystem service (Santos-Martín and others, 2019).

Accounting for ecosystem services

A2.33 Purpose of accounting for ecosystem services

In the ecosystem accounting framework, ecosystem services serve as the concept connecting ecosystem assets and the production and consumption activity of businesses, households and governments. The measurement of ecosystem services is thus central to describing an integrated set of ecosystem accounts. An important feature of the rationale for accounting for ecosystem services is that while much economic production (for example, in agriculture, forestry and fisheries) uses inputs directly from ecosystems, those inputs (and any associated degradation) are not explicitly recorded in the national accounting framework. In ecosystem accounting, ecosystem services are clearly differentiated from the goods and services that are produced, that is to say, the ecosystem services are recorded as the contributions of ecosystem assets to the production of those goods and services. In effect, this approach extends supply chains and treats ecosystem assets as suppliers or producing units

A2.34 Concepts and principles in accounting for ecosystem services

- ***Ecosystem service***

Ecosystem services are the contributions of ecosystems to the benefits that are used in economic and other human activity. In ecosystem accounting, ecosystem services are recorded as flows between ecosystem assets and economic units, where economic units encompass the various institutional types included in the national accounts, such as businesses, governments and households.

- **Benefits**

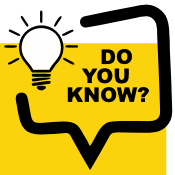
Benefits are the goods and services that are ultimately used and enjoyed by people and society. The use of the term "benefit" in ecosystem accounting is derived from, but is applied more broadly than, the SNA definition of an economic benefit. In the 2008 SNA. Benefits are treated as either SNA benefits or non-SNA benefits. SNA benefits are goods and services that are included in the production boundary of the SNA. Examples of SNA benefits include all food, water, energy, clothing, shelter and recreation services available for purchase. Non-SNA benefits are goods and services that are not included in the production boundary of the SNA. Examples of non-SNA benefits include clean air and flood protection provided by ecosystems.

- **Final and intermediate ecosystem services**

Final ecosystem services are those ecosystem services in which the user of the service is an economic unit. Intermediate services are those ecosystem services in which the user of the eco system services is an ecosystem asset and where there is a connection to the supply of final ecosystem services.

- **Framing of contributions to benefits from the environment**

SEEA EA adopts a framing of contributions from the environment that distinguishes (a) ecosystem services; (b) abiotic flows; and (c) spatial functions, as shown in table below.



India has published accounts for various environmental assets-forests, water, minerals, energy, and solid waste-and developed monetary valuations for ecosystem services such as crop provisioning, timber and non-timber forest products, fish provisioning, carbon retention, nature-based tourism, and soil erosion prevention.

Table A2.9: Contribution and benefit of the Environment

Framing of contributions to benefits from the environment	
Ecosystem services Provisioning services Regulating and maintenance services Cultural services	
Abiotic flows	Geophysical sources Flows related to geophysical processes including abstraction of water (including ground-water) and capture of wind, solar, tidal, geothermal and similar sources of energy.
	Geological resources Flows related to geological resources including extraction of fossil fuel, mineral, ores, sand and gravel
Spatial functions	Flows related to the use of the environment as a location for transportation and movement and for buildings and structures
	Flows related to the use of the environment as a sink for pollutants and waste (excluding the remediation of pollutants and wastes recorded as ecosystem services)

This framing has the following key features:

• Ecosystem services are distinct from abiotic flows, while both reflect contributions from the environment.

• Ecosystem services are underpinned by various ecological characteristics and processes that involve both biotic and abiotic components to varying degrees. Thus, ecosystem services encompass services that are both predominantly biotic (e.g. air filtration services provided by forests) and predominantly abiotic (e.g. coastal protection services provided by sand dunes). **Details of ecosystem services are given below:**

a. Provisioning services are those ecosystem services representing the contributions to benefits that are extracted or harvested from ecosystems. **Examples of ecosystem service provided by forest are Timber and fuelwood,** non-timber forest products (e.g., fruits, medicinal plants), Freshwater (in watersheds) etc.

b. Regulating and maintenance services are those ecosystem services result ing from the ability of ecosystems to regulate biological processes and to influence climate, hydrological and biochemical cycles and thereby maintain environmental conditions beneficial to individuals and society. **Examples of ecosystem service provided by forest are Air purification**, Climate regulation, Erosion control, Flood mitigation etc.

c. Cultural services are the experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contribute to a range of cultural benefits. Examples of ecosystem service provided by forest are **Recreation and tourism, Spiritual and religious values, Educational and scientific knowledge etc.**

• **Abiotic flows** arise through the abstraction and extraction of resources, where a distinction is made between those flows related to geophysical sources (i.e. sources related to climate and the atmosphere) and those related to geological resources. Depending on the location of the resources and the point of abstraction or extraction, geological resources may be attributed as flows from ecosystem assets (e.g. sand and gravel) or from deep geological resources. Examples of abiotic flows in forest ecosystems are water flow, nutrient cycling, carbon flow, energy flow, Soil erosion and sediment transport etc. Abiotic flows are critical for Supporting plant growth, Regulating ecosystem productivity, habitat conditions etc.

• **Spatial functions** are treated neither as ecosystem services nor as abiotic flows. Two main types are identified: (a) use of the environment for transportation and movement on land or water or through the air or as a base for buildings and structures; and (b) use of the environment as a location in which pollutants and waste are deposited, that is, use of the environment as a sink (excluding the remediation of such residuals by ecosystems, which is treated as an ecosystem service).

The spatial functions of forests refer to the ways forests contribute to environmental stability and ecosystem processes through their geographic presence, structure, and distribution across landscapes. These functions are especially important in maintaining ecological balance, supporting biodiversity, and delivering ecosystem services at local, regional, and global scales. Examples of spatial functions of forest ecosystem are flood control by forest watershed, erosion control by hillside forest, air purification by urban forest, Mangrove forests protect coastlines, Mosaic landscapes with mixed forest types support rich biodiversity. Etc.

• Principles underpinning the reference list of selected ecosystem services

There is a wide range of ecosystem services that fall within the conceptual scope of the definition of ecosystem services. Notwithstanding significant advances in the development of classifications of ecosystem services, in particular the Common International Classification of Ecosystem Services (CICES) and the National Ecosystem Services Classification System (NESCS Plus), an internationally agreed classification of ecosystem services has not been finalized. In its absence, a reference list of selected ecosystem services has been developed for SEEA EA by combining the findings derived from work related to CICES and NESCS; work under other initiatives on the typology and classification of ecosystem services (e.g. the Millennium Ecosystem Assessment, TEEB and the "nature's contributions to people" approach of IPBES) and the outcomes of the consultation on the revision of SEEA EA.

The table A2.10 utilizes the CICES V5.2 framework[43] to provide a structured classification of ecosystem services delivered by forest ecosystems. The table identify and describes the full spectrum of provisioning, regulating, and cultural services associated with forests. While not exhaustive, the categories and descriptors presented serve as an indicative reference for mapping and valuing forest ecosystem contributions to human well-being and economic activity. The framework supports comparability and consistency in ecosystem service assessment, facilitating integration with broader ecosystem accounting initiatives such the SEEA EA.

[43]Haines-Young, R. (2023): Common International Classification of Ecosystem Services (CICES) V5.2 and Guidance on the Application of the Revised Structure. [Available from www.cices.eu]

Table A2.10: Forest Ecosystem Services and its Classification

SEEA	*SEEA (Subtypes)*	*SEEA Description*	*CICES (V5.2) Class*
Biomass provisioning services	Grazed biomass provisioning services	Grazed biomass provisioning services are the ecosystem contributions to the growth of grazed biomass that is an input to the growth of cultivated livestock. This service excludes the ecosystem contributions to the growth of crops used to produce fodder for livestock (e.g., hay, soybean meal). These contributions are included under crop provisioning services. This is a final ecosystem service but may be intermediate to livestock provisioning services.	Fibres and other materials from wild plants for direct use or processing (excluding genetic materials)
	Wood provisioning services	Wood provisioning services are the ecosystem contributions to the growth of trees and other woody biomass in both cultivated (plantation) and uncultivated production contexts that are harvested by economic units for various uses including timber production and energy. This service excludes contributions to non-wood forest products. This is a final ecosystem service.	Fibres and other materials from wild plants for direct use or processing (excluding genetic materials)
			Wild plants (terrestrial and aquatic, including fungi, algae) used as a source of energy

SEEA	SEEA (Subtypes)	SEEA Description	CICES (V5.2) Class
	Wild animals, plants and other biomass provisioning services	Wild animals, plants and other biomass provisioning services are the ecosystem contributions to the growth of wild animals, plants and other biomass that are captured and harvested in uncultivated production contexts by economic units for various uses. The scope includes non-wood forest products (NWFP) and services related to hunting, trapping and bio-prospecting activities; but excludes wild fish and other natural aquatic biomass (included in previous class). This is a final ecosystem service	Wild plants (terrestrial and aquatic, including fungi, algae) used for nutrition
			Fibres and other materials from wild plants for direct use or processing (excluding genetic materials)
			Wild plants (terrestrial and aquatic, including fungi, algae) used as a source of energy
Genetic material services		Genetic material services are the ecosystem contributions from all biota (including seed, spore or gamete production) that are used by economic units, for example (i) to develop new animal and plant breeds; (ii) in gene synthesis; or (iii) in product development directly using genetic material. This is most commonly recorded as an intermediate service to biomass provisioning.	Seeds, spores and other plant materials collected for maintaining or establishing a population
			Higher and lower plants (whole organisms) used to breed new strains or varieties
			Individual genes extracted from higher and lower plants for the design and construction of new biological entities

SEEA	SEEA (Subtypes)	SEEA Description	CICES (V5.2) Class
Global climate regulation services		Global climate regulation services are the ecosystem contributions to the regulation of the chemical composition of the atmosphere and oceans that affect global climate through the accumulation and retention of carbon and other GHG (e.g., methane) in ecosystems and the ability of ecosystems to remove (sequester) carbon from the atmosphere. This is a final ecosystem service.	Regulation of chemical composition of atmosphere and oceans, and the maintenance of continental atmospheric/oceanic circulation patterns
Rainfall pattern regulation services (at sub-continental scale)		Rainfall pattern regulation services are the ecosystem contributions of vegetation, in particular forests, in maintaining rainfall patterns through evapotranspiration at the sub-continental scale. Forests and other vegetation recycle moisture back to the atmosphere where it is available for the generation of rainfall. Rainfall in interior parts of continents fully depends upon this recycling. This may be a final or intermediate service.	Regulation of chemical composition of atmosphere and oceans, including maintaining rainfall patterns through evapotranspiration at the sub-continental scale
Air filtration services		Air filtration services are the ecosystem contributions to the filtering of air-borne pollutants through the deposition, uptake, fixing and storage of pollutants by ecosystem components, particularly plants, that mitigates the harmful effects of the pollutants. This is most commonly a final ecosystem service.	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals
			Smell reduction
Soil and sediment retention services	soil erosion control services	Soil erosion control services are the ecosystem contributions, particularly the stabilising effects of vegetation, that reduce the loss of soil (and sediment) and support use of the environment (e.g., agricultural activity, water supply). This is may be recorded as a final or intermediate service.	Control of water erosion rates
			Control of wind erosion rates

SEEA	SEEA (Subtypes)	SEEA Description	CICES (V5.2) Class
	Landslide mitigation	Landslide mitigation services are the ecosystem contributions, particularly the stabilising effects of vegetation, that mitigates or prevents potential damage to human health and safety and damaging effects to buildings and infrastructure that arise from the mass movement (wasting) of soil, rock and snow. This is a final ecosystem service.	Buffering and attenuation of mass movement
Solid waste remediation		Solid waste remediation services are the ecosystem contributions to the transformation of organic or inorganic substances, through the action of micro-organisms, algae, plants and animals that mitigates their harmful effects. This is may be recorded as a final or intermediate service.	Bio-remediation by micro-organisms, algae, plants, and animals
			Filtration/sequestration/ storage/accumulation by micro-organisms, algae, plants, and animals
Water purification services (water quality amelioration)	Retention and breakdown of nutrients	Water purification services are the ecosystem contributions to the restoration and maintenance of the chemical condition of surface water and groundwater bodies through the breakdown or removal of nutrients and other pollutants by ecosystem components that mitigate the harmful effects of the pollutants on human use or health. This may be recorded as a final or intermediate ecosystem service.	Regulation of the chemical condition of freshwaters by living processes
	Retention and breakdown of other pollutants		Bio-remediation by micro-organisms, algae, plants, and animals
Pollination services		Pollination services are the ecosystem contributions by wild pollinators to the fertilization of crops that maintains or increases the abundance and/or diversity of other species that economic units use or enjoy. This may be recorded as a final or intermediate service.	Pollination (or 'gamete' dispersal in a marine context)

SEEA	SEEA (Subtypes)	SEEA Description	CICES (V5.2) Class
Biological control services	Pest control services	Biological control services are the ecosystem contributions to the reduction in the incidence of species that may prevent or reduce the effects of pests on biomass production processes or other economic and human activity. This is may be recorded as a final or intermediate service.	Pest control (including invasive species)
	Disease control services	Disease control services are the ecosystem contributions to the reduction in the incidence of species that may prevent or reduce the effects of species on human health. This is most commonly a final ecosystem service.	Disease control
Other regulating and maintenance services			Visual screening
			Fire protection
			Seed dispersal
Recreation-related services		Recreation-related services are the ecosystem contributions, in particular through the biophysical characteristics and qualities of ecosystems, that enable people to use and enjoy the environment through direct, in-situ, physical and experiential interactions with the environment. This includes services to both locals and non-locals (i.e. visitors, including tourists). Recreation-related services may also be supplied to those undertaking recreational fishing and hunting. This is a final ecosystem service.	Elements of living systems that enable activities promoting health, recuperation or enjoyment through active or immersive interactions
Visual amenity services		Visual amenity services are the ecosystem contributions to local living conditions, in particular through the biophysical characteristics and qualities of ecosystems that provide sensory benefits, especially visual. This service combines with other ecosystem services, including recreation-related services and noise attenuation services to underpin amenity values. This is a final ecosystem service.	Elements of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions

SEEA	SEEA (Subtypes)	SEEA Description	CICES (V5.2) Class
Education, scientific and research services		Education, scientific and research services are the ecosystem contributions, in particular through the biophysical characteristics and qualities of ecosystems, that enable people to use the environment through intellectual interactions with the environment. This is a final ecosystem service.	Elements of living systems that enable scientific investigation or the creation of traditional ecological knowledge
Spiritual, artistic and symbolic services		Spiritual artistic and symbolic services are the ecosystem contributions, in particular through the biophysical characteristics and qualities of ecosystems, that are recognised by people for their cultural, historical, aesthetic, sacred or religious significance. These services may underpin people's cultural identity and may inspire people to express themselves through various artistic media. This is a final ecosystem service.	Elements of living systems that are resonant in terms of culture or heritage
			Elements of living systems that enable aesthetic experiences
			Elements of living systems used for entertainment or representation outside the setting concerned
			Elements of living systems that have symbolic meaning, capture the distinctiveness of settings or their sense of place
			Elements of living systems that have spiritual or religious meaning

SEEA	SEEA (Subtypes)	SEEA Description	CICES (V5.2) Class
Ecosystem and species appreciation services		Ecosystem and species appreciation concerns the wellbeing that people derive from the existence and preservation of the environment for current and future generations, irrespective of any direct or indirect use.	Elements or features of living systems whose contemporary existence or conservation is important to people
			Elements or features of living systems whose inter-generational existence or conservation is important to people.

Sourse: https://cices.eu/content/uploads/sites/8/2023/08/CICES_V5.2_29082023.xlsx

Accounting for ecosystem services in physical terms

A2.35 Introduction: The aim of accounting for ecosystem services in physical terms is to record, in an accounting structure, the flows of ecosystem services over an accounting period in physical units such as cubic metres or tons. A key focus in accounting for ecosystem services is reconciliation of the supply and use of ecosystem services across multiple ecosystem assets and multiple users. Ecosystem services flow accounts in physical terms that record the supply and use of ecosystem services may be compiled for a range of reasons and purposes. These include recording and monitoring the different bundles of ecosystem services supplied by different ecosystem types, identifying the users of the services and assessing how these patterns of supply and use are changing over time. The information on ecosystem services in physical terms can also be used to demonstrate the nature of the connection to the SNA production boundary, which, in turn, can support engagement and discussion of the wider, non-private benefits of eco systems extending beyond ecosystem contributions to marketed goods and services.

A2.36 Ecosystem services flow accounts in physical terms: The structure of the ecosystem services flow accounts in physical terms is displayed in below tables. The structure of these tables follows that of the SUTs described in the SNA and the SEEA Central Framework. In an ecosystem accounting context, SUTs are accounting tables structured to record flows of final ecosystem services between economic units and ecosystems and flows of intermediate services among ecosystems. Entries can be made in physical and monetary terms. Conceptually, an SUT in physical terms would contain only entries recorded in the same measurement unit. Different ecosystem services provided by forest may be recorded using its own measurement units. Consequently, it is not possible to aggregate down the rows in the tables to obtain meaningful aggregates. While individual SUTs for each ecosystem service could be presented, the conceptual considerations concerning the structure of the tables and associated accounting entries would be identical to those discussed here. A key principle underpinning the SUT structure is that the supply of eco system services must equal the use of those services during an accounting period. This is an application of the supply and use. Thus, both the supply and the use of services provided by forest should be recorded using the same measurement unit.

Table A2.11: Physical Supply and use table (PSUT)

Supply														
		Type of economic units						Ecosystem type			Total supply by resident ecosystem asset	Supply from non-resident ecosystem assets - Imports	Total supply by ecosystem assets	TOTAL SUPPLY
	Measurement unit	Industries	Government	Households	Total supply for residential economic unit	Supply by non-resident economic units – Imports	Total supply by economic unit	Terrestrial	Freshwater	Marine				
Provisioning services														
Regulating and maintenance services														
Cultural services														
USE														
		Type of economic units						Ecosystem type			Total use by resident ecosystem asset	use from non-resident ecosystem assets - Imports	Total use by ecosystem assets	Total use
Ecosystem services	Measurement unit	Industries	Government	Households	Total use for residential economic unit	use by non-resident economic units – export	Total use by economic unit	Terrestrial	Freshwater	Marine				
Provisioning services														
Regulating and maintenance services														
Cultural services														

Note: This table provides the general structure of the ecosystem services flow accounts by different ecosystem types. It can be modified for each ecosystem accordingly.

A single supply and use table are compiled for one accounting period (usually one year), that is, the entries for supply and use show the total flows of each ecosystem service for that time period

In addition to the requirement of matched supply and use entries, the following key features of supply and use accounting are applied:

1. Supply is attributed to an ecosystem type. Where an ecosystem service is supplied jointly by a combination of ecosystems, it is assumed that, if required, the supply can be allocated to individual assets using spatial allocation methods or measurement conventions.

2. Use of final ecosystem services is attributed to resident economic units (business, government, households) or non-resident economic units (exports).

3. Use of intermediate services is attributed to an ecosystem type.

4. For any single transaction of an ecosystem service (i.e. where there is a supply-use pair), the magnitude of the flow is the same for both supply and use in terms of quantity and monetary value.

5. Where there are multiple transactions of a single ecosystem service (i.e. where there are multiple supply-use pairs), the SUT allows supply from multiple ecosystem types and use by multiple users to be recorded. Where a total flow pertaining to multiple ecosystem types or multiple users is estimated, attribution to relevant ecosystem types and users would be required to best reflect the underlying transactions.

Using these principles allows the data recorded in the SUT to support the monetary valuation of ecosystem services and to be considered in alignment with the economic data recorded in the SNA SUT

A2.37 Purposes of monetary valuation in ecosystem accounting: In ecosystem accounting, the primary motivation for monetary valuation using a common monetary unit or numeracies is to have the ability to make comparisons of different ecosystem services and ecosystem assets that are consistent with standard measures of products and assets as recorded in national accounts. This requires the use of exchange values, which in turn facilitates a core ambition of SEEA EA, namely, the description of an integrated system of prices and quantities for the economy and the environment.
Monetary valuation depends on two factors in an accounting context, namely, (a) the definition and scope of goods, services and assets included; and (b) the valuation concept that is used. In ecosystem accounting, the valuation concept applied is the concept of exchange values. As this is the same valuation concept applied in the SNA, it is therefore a concept that supports comparison and integration with national accounts estimates and a range of analytical and indicator applications as noted above.

Accounting for ecosystem services in monetary terms

A2.38 Introduction: Recording monetary values for ecosystem services underpins the compilation of two of the ecosystem accounts: the ecosystem services flow account in monetary terms and the monetary ecosystem asset account. The ecosystem services flow account in monetary terms records the monetary value of flows of ecosystem services based on their exchange values. The data from this account can be used to understand the relative economic significance of different ecosystem services (within the valuation framing of the national accounts); support aggregation of ecosystem services for the purpose of comparing the role of different ecosystem assets; understand changes in monetary value over time; underpin comparison of the inputs of different ecosystem services to different users; and support understanding of the role of ecosystem services in different locations, for example, across countries. In addition, the use of exchange values in an accounting context requires drawing clear links between the supply of ecosystem services and the users of ecosystem services. Establishing these links can highlight both the economic costs arising from the loss of ecosystem services and the role of government as a provider of public goods. Estimates of the monetary value of ecosystem services are recorded in the eco system services flow account in monetary terms. This account follows the structure of an SUT and has the same underlying structure as the ecosystem services flow account in physical terms.

Generally, entries recorded in the monetary ecosystem services flow account should correspond directly to those recorded in the physical ecosystem services flow account described earlier. Thus:

1. The definition and measurement scope of each ecosystem service is the same as in the PSUT, including the treatment and recording of intermediate ser vices, imports and exports of ecosystem services, subsistence production of agricultural and related products and abiotic flows.
2. The flow recorded in physical terms should be consistent with the entry in monetary terms; i.e. examination of the accounts in physical and monetary terms should support a coherent picture of supply and use of ecosystem services.
3. Allocation of ecosystem services supply to the various users of ecosystem services should be consistent with allocation in the PSUT. It is to be noted that the user should not be determined on the basis of choice of valuation method.
4. The accounting period should be the same as that for the PSUT.

A2.39 Techniques for valuing transactions in ecosystem services: The general advice of the SNA is that where directly observed market prices are not available, they may be estimated by using prices from similar or related markets or by using costs of production. Following a similar framing, it is recommended that choice of the type of valuation methods to be applied be made according to the following order, from highest to lowest preference.

(a) Methods where the price for the ecosystem service is directly observable;
(b) Methods where the price for the ecosystem service is obtained from markets for similar goods and services;
(c) Methods where the price for the ecosystem service is embodied in a market transaction; (d)Methods where the price for the ecosystem services is based on revealed expenditures (costs) for related goods and services;
(e) Methods where the price for the ecosystem service is based on expected expenditures or expected markets.

In an SEEA EA context, the aim is to record entries in the accounts for multiple ecosystem services across multiple ecosystem types. In principle, aggregation across ecosystem services and ecosystem types is possible even where different valuation methods are used, provided that the different methods are focused on applying the same target valuation concept. This principle is also applied in the national accounts to aggregate across market and non-market goods and services.

A2.40 Accounting for ecosystem assets in monetary terms: The monetary ecosystem asset account also records the changes in the monetary value of ecosystem assets over an accounting period including changes due to ecosystem degradation, ecosystem enhancement, ecosystem conversions and revaluations. The monetary ecosystem asset account records the monetary values of all eco system assets within an EAA at the beginning (opening) and end (closing) of each accounting period, as well as changes in the value of those assets over the accounting period. Changes in the monetary value of ecosystem assets are separated into five broad types: ecosystem enhancement, ecosystem degradation, ecosystem conversions, other changes in the volume of ecosystem assets, and revaluations as a result of price changes. The basic accounting structure for the monetary ecosystem asset account is shown in table below-

Table A2.12: Basic Accounting Structure for Monetary Ecosystem Asset Account

Ecosystem							
Accounting entries	Forests	Lakes	Cropland	Urban areas	Wetlands	Seagrass	Total
Opening value							
Ecosystem enhancement							
Ecosystem degradation							
Ecosystem conversions							
other changes							
Net change in value							
Closing value							

Note that ecosystem may further classified by ecosystem type using selected Ecosystem Functional Group (EFGs) from IUCN GET

GLOSSARY

Term	Definition
A	
Above-Ground Biomass (AGB)	Component of the carbon pool consisting of all living Vegetation above the soil, inclusive of stems, stumps, branches, bark, seeds and foliage.
Adaptation	Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities.
Afforestation	Establishment of forest through planting and/or deliberate seeding on land that, until then, was under a different land use, implies a transformation of land use form non-forest to forest.
Agricultural Land	Land primarily used for farming and for production of food, fibres and other commercial and horticultural crops.
Assets	Assets are stores of value representing a benefit or series of benefits accruing to an economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another.
Atmosphere	The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium, radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio) and ozone. In addition, the atmosphere contains water vapour, whose amount is highly variable but typically 1% volume mixing ratio. The atmosphere also contains clouds and aerosols.

B

Base Year	A base year in estimation of GDP is the reference year whose prices are used to calculate real growth. Methodology & data sources are also fixed during the base year for maintaining comparability throughout the series.
Below-Ground Biomass (BGB)	Component of carbon pool consisting of the biomass contained within live roots.
Biodiversity	Variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of Ecosystems. It is a measure of ecosystem health.
Biological Resources	Renewable resources that are capable of regeneration through natural (non–managed or managed) processes. Include timber and aquatic resources and a range of other animal and plant resources (such as livestock, orchards, crops and wild animals), fungi and bacteria.
Biome	A distinct community of plants, animals or fungi that occupy a distinct region. It is often referred to as an ecosystem.
Biosphere	Part of the Earth system comprising all ecosystems and living organisms, in the atmosphere, on land (terrestrial biosphere) or in the oceans (marine biosphere), including derived dead organic matter, such as litter, soil organic matter and oceanic detritus.

C

Canopy	The cover of branches and foliage formed by the crowns of trees.
Canopy Cover	Percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants.

Canopy Density	Percent area of land covered by the canopy of trees. It is expressed as a decimal coefficient, taking closed canopy as unity.
Carbon Cycle	All parts (reservoirs) and fluxes of carbon. The cycle is usually thought of as four main reservoirs of carbon interconnected by pathways of exchange. The reservoirs are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans and sediments (includes fossil fuels). The annual movements of carbon, the carbon exchanges between reservoirs, occur because of various chemical, physical, geological and biological processes. The ocean contains the largest pool of carbon near the surface of the Earth, but most of that pool is not involved with rapid exchange with the atmosphere.
Carbon Dioxide	A naturally occurring gas and also a by–product of burning fossil fuels and biomass, as well as land–use changes and other industrial processes. It is the principal human caused greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured.
Carbon Pool	Components of an ecosystem that can either accumulate or release carbon.
Carbon Sequestration	It is a natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form.
Carbon Sinks	Natural systems, such as oceans and forests, that absorb more carbon dioxide than they release, helping to reduce greenhouse gases in the atmosphere.
Carbon Storage	The capacity of ecosystems to retain carbon over time, providing climate regulation benefits.

Climate	Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation and wind.
Climate Change	Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. (Source – UNFCCC).
Climate Change Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Climate Change Mitigation	Efforts to reduce or prevent greenhouse gas emissions and may involve using new technologies, incorporating and increasing renewable energies, making older equipment more energy efficient and changing management practices or consumer behavior. Protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture or green agriculture, are also elements of mitigation.
Climate Change–related Statistics	According to UNECE, environmental, social and economic data that measure the human causes of climate change, the impacts of climate change on human and natural systems and the efforts by humans to avoid and adapt to these consequences.
Closing Stock	Closing Stock refers to the quantity available at the end of the accounting period after incorporating any additions and deductions in the stock.
Constant Price	Constant Price measures the value of goods at the price of a fixed year known as the base year.

Cultural Services	The non-material benefits people obtain from ecosystems are called cultural services. They include aesthetic inspiration, cultural identity, sense of home, and spiritual experience related to the natural environment. Typically, opportunities for tourism and for recreation are also considered within the group.
Current Price	Current price measures the value of goods at the actual prevailing price in the country

D

Dead Organic Matter (DOM)	Component of carbon pool that contains all non-living woody biomass and can be divided into wood (fallen trees, roots and stumps with diameter over 10cm) and litter (greater than 2mm and less than 10cm diameter) components.
Deciduous	These are the forest types that are predominantly composed of species, which shed their leaves once a year, especially during summer. It also includes tree clad area with tree cover lying outside the notified forest boundary areas that are herbaceous with a woody appearance.
Deforestation	The conversion of forest to other land use independently whether human-induced or not. It includes areas of forest converted to agriculture, pasture, water reservoirs, mining, and urban areas. (Source – GFRA, 2020).
Desertification	Land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities. (Source - https: //catalogue.unccd. int/1195_Desertification.pdf, 26.07.2024)
Disasters	Unforeseen and often sudden events that cause great damage, destruction and human suffering. They often exceed local response capacities and require external assistance at the national or international level. Depending on their cause, disasters can be both natural and technological.

E

Ecosystem	A dynamic complex of plant, animal and microorganism communities and their non–living environment Interacting as a functional unit.
Ecosystem Accounting	Ecosystem accounting is a coherent framework for integrating measures of ecosystems and the flows of services from them with measures of economic and other human activity. Ecosystem accounting complements, and builds on, the accounting for environmental assets as described in the System of Environmental-Economic Accounting (SEEA) Central Framework (e.g. water resources, soil resources). In ecosystem accounting as described in the SEEA Ecosystem Accounting (SEEA EA), the accounting approach recognizes that these individual resources function in combination within a broader system and within a given spatial area.
Ecosystem Assets	Spatial areas comprising a combination of biotic and abiotic components and other elements which function together. Some examples are forests and wetlands.
Ecosystem Condition	Overall quality of an ecosystem asset in terms of its characteristics. Measures of ecosystem condition are generally combined with measures of ecosystem extent to provide an overall measure of the state of an ecosystem asset.
Ecosystem Condition Account	This account organizes biophysical information on the condition of different ecosystem types. The ecosystem condition account organizes data on selected ecosystem characteristics and the distance to a reference condition to provide insight into the ecological integrity of ecosystems.
Ecosystem Extent	Size of an ecosystem asset, commonly in terms of spatial area.
Ecosystem Extent Account	This account serves as a common starting point for ecosystem accounting. It organizes information on the extent of different ecosystem types (e.g. forests, wetlands, agricultural areas, marine areas) within a country in terms of area.
Ecosystem Services	Benefits supplied by the functions of ecosystems and received by humanity.

Ecosystem Services Flow Account (physical and monetary terms)	This set of ecosystem accounts measures the supply of ecosystem services and the use of those services by economic units, including households, enterprises and Government.
Environmental-Economic Accounting	Environmental-economic accounts are integrated statistics that illuminate the relationship between the environment and the economy, both the impacts of the economy on the environment and the contribution of the environment to the economy. Environmental-economic accounts can provide information about the extraction of natural resources, their use within the economy, natural resource stock levels, the changes in those stocks during a specific period and economic activity related to the environment. Environmental economic accounts present this information in physical and monetary terms, as appropriate.
Evergreen/Semi-Evergreen	This category comprises of tall trees, which predominantly remain green throughout the year. It includes both coniferous and tropical broad-leaved evergreen species. Semi- evergreen is a forest type that includes a combination of evergreen and deciduous species with the former dominating the canopy cover.
Extraction	Extractions are reductions in stock due to the physical removal or harvest of an environmental asset through a Process of production.

F

Forest Inventory	The measurement of certain parameters of forests to assess the growing stand and stock and other characteristics of forests.

G

Gross Value Added (GVA)	In India's national accounts, Gross Value Added (GVA) is the total value of goods and services produced in the economy after deducting the value of intermediate consumption (the value of goods and services used up in the process of production). GVA = Output – Intermediate Consumption

Growing Stock	The sum (by number or volume) of all the trees Growing/living in the forest or a specified part of it.

H

Habitat	Site or environment where a plant or animal lives, such as forest.

I

Intergovernmental Panel on Climate Change (IPCC)	The IPCC was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. With its capacity for reporting on climate change, its consequences and the viability of adaptation and mitigation measures, the IPCC is also looked to as the official advisory body to the world's governments on the state of the science of the climate change issue. For example, the IPCC organized the development of internationally accepted methods for conducting national greenhouse gas emission inventories.

L

Land	Space provided for natural ecosystems, human habitats and human activities. As this space is finite, the expansion of human activities can reduce the space occupied by natural ecosystems, thus reducing ecosystems' capacity to yield ecosystem goods and services for all living beings. From the resource perspective, land is a unique environmental resource that delineates the space in which economic activities and environmental processes take place and within which environmental resources and economic assets are located.

Land Cover	Land cover refers to the observed physical and biological cover of the Earth's surface and includes natural vegetation and abiotic (non-living) surfaces.
Land Use	Reflects both the activities undertaken and the institutional arrangements put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions. Land being "used" means the existence of some kind of human activity or management. Consequently, there are areas of land that are "not in use" by human activities.
Land with Dense Scrub	Areas with scrubs dominating the landscape and having shallow and skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and are subjected to excessive aridity. They have a tendency for intermixing with croplands.
Land with Open Scrub	Similar to land with dense scrub, except that it has sparse Vegetative cover or is devoid of scrub and has a thin soil cover.
Litter	Woody material of trees having diameter < 5 cm which is not decomposed.
Littoral/Swamp/Mangrove Forest	Areas on coastal tidal flats, estuaries salt marshes etc where the canopy cover/density is above 10% and tropical and subtropical vegetation species are densely colonized.

M

Managed Expansion/ Regression	Managed expansion / regression represents an increase /decrease in the area of a land cover type due to human activity. Generally, the managed expansion /regression of one land cover type will also lead to the recording of a matching entry for managed regression /expansion of another land cover type. A matching entry is not recorded if there is a managed expansion in the total area of land within scope of the account (e.g., in the case of land reclamation).

Mitigation	A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

N

Natural Expansion/ Regression	Natural expansion / regression is an increase /decrease in area resulting from natural processes including seeding, sprouting, suckering, layering or erosion by sea. As in the case of managed expansion /regression, generally, the natural expansion of one land cover type will also lead to the recording of a matching entry for natural regression of another land cover type. A matching entry is not recorded if there is a natural expansion /regression in the total area of land (e.g., in the case where land is created through volcanic activity or landslide or eroded by sea).

O

Open Forest	Lands with forest cover having a canopy density between >10 and<40 %.
Opening Stock	Opening Stock refers to the quantity available at the beginning of the accounting period.
Other Wooded Land	Land not classified as “Forest”, spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover of 5–10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.

P

Protected Areas	Protected area means a National Park, a Sanctuary, a Conservation Reserve or a Community Reserve notified under sections 18, 35, 36A and 36C of the Wildlife Protection Act.

R

Recorded Forest Area (RFA)	Area recorded as forest in Government records.
Reforestation	Planting of forests on lands that have previously contained forests but that have been converted to some other use.
Remote Sensing	Science of obtaining information about objects or areas from a distance, typically from aircraft or satellites.
Reserved Forests (RF)	An area so constituted under the provisions of the Indian Forest Act or other State Forest Acts, having full degree of protection. In reserved forests all activities are prohibited unless permitted.
Runoff	Water which is not absorbed by the soil and flows to lower ground, eventually draining into a stream, river, or other body of water. It is that part of precipitation that flows toward the streams on the surface of the ground or within the ground. Runoff is composed of base flow and surface runoff.

S

Scrub	Forest lands having canopy density less than 10 percent, generally with Shrubs interspersed with trees.

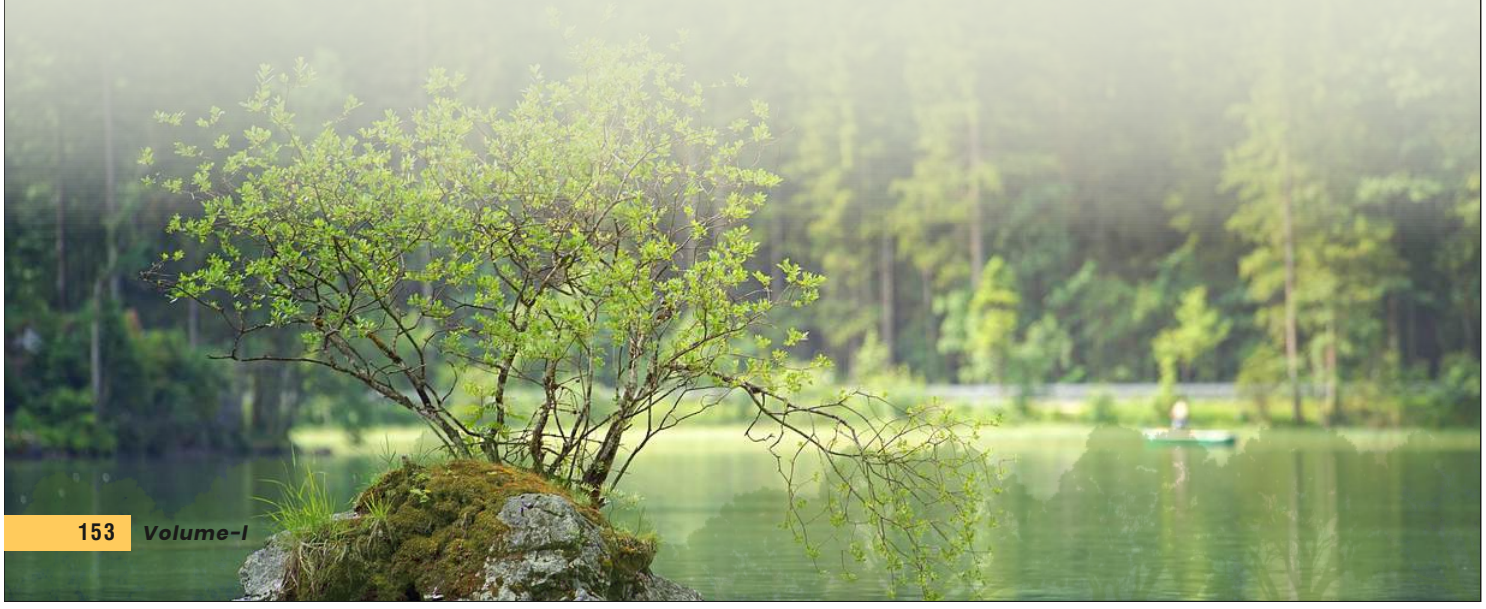
Sink	Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol from the atmosphere.
Social Cost of Carbon	The social cost of carbon (SCC) is an estimate, in dollars, of the economic damages that would result from emitting one additional ton of carbon dioxide into the atmosphere.
Soil Erosion	The displacement of the soil by the action of water or wind. Soil erosion is a major process of land degradation.
Soil Resources	Comprise the top layers (horizons) of soil that form a Biological system.
Species	Group of individual specimens having close resemblance but differing from others and belonging to the same genus.
Stream Flow	Volume of water that moves over a designated point over a fixed period of time. It is often expressed as cubic feet per second.
Sustainable Development Goals	It is known as global goals, and are adopted as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace as well as prosperity by 2030. All United Nations Member States adopted these goals in 2015.
System of Environmental-Economic Accounting (SEEA)	The System of Environmental Economic Accounting (SEEA) is the accepted international standard for environmental-economic accounting, providing a framework for organizing and presenting statistics on the environment and its relationship with the economy. It brings together economic and environmental information in an internationally agreed set of standard concepts, definitions, classifications, accounting rules and tables to produce internationally comparable statistics. The SEEA is produced and released under the auspices of the United Nations, the European Commission, the Food and Agriculture Organization of the United Nations, the Organization for Economic Co-operation and Development, International Monetary Fund and the World Bank Group.

T

Tree Cover	Tree cover comprises all tree patches outside the forest area, which are less than one hectare in extent including all the scattered trees found in the rural and urban settings, and not captured under the forest cover assessment.

W

Watershed	The geographic area through which water flows across the land and drains into a common body of water, whether a stream, river, lake, or ocean.
Weather	Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness and precipitation. In most places, weather can change from hour–to–hour, day–to–day and season–to–season. Climate in a narrow sense is usually defined as the "Average weather".
Wetlands	Areas of land that are either temporarily or permanently covered by water. These are neither truly aquatic nor terrestrial; it is possible that wetlands can be both at the same time depending on seasonal variability. These could be natural or man–made and found both in the inland and coastal areas.



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