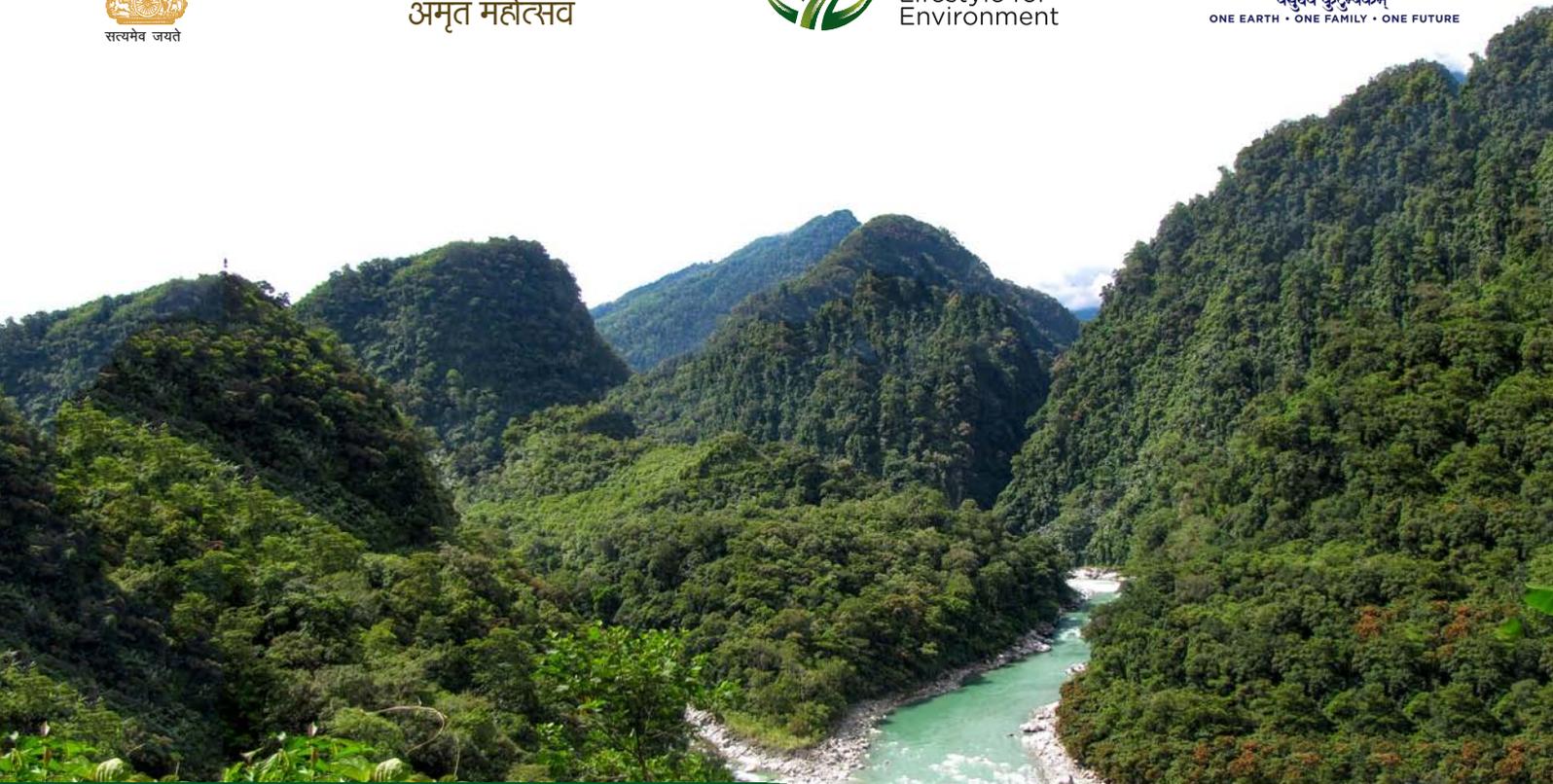




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# INTERNATIONAL WORKSHOP

## Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination



**Dates: 22-24 March 2023**  
**Venue: Dehradun, Uttarakhand, INDIA**

**Indian Council of Forestry Research and Education**  
(Ministry of Environment, Forest and Climate Change, Government of India)  
P.O. New Forest, Dehradun – 248006, Uttarakhand, INDIA  
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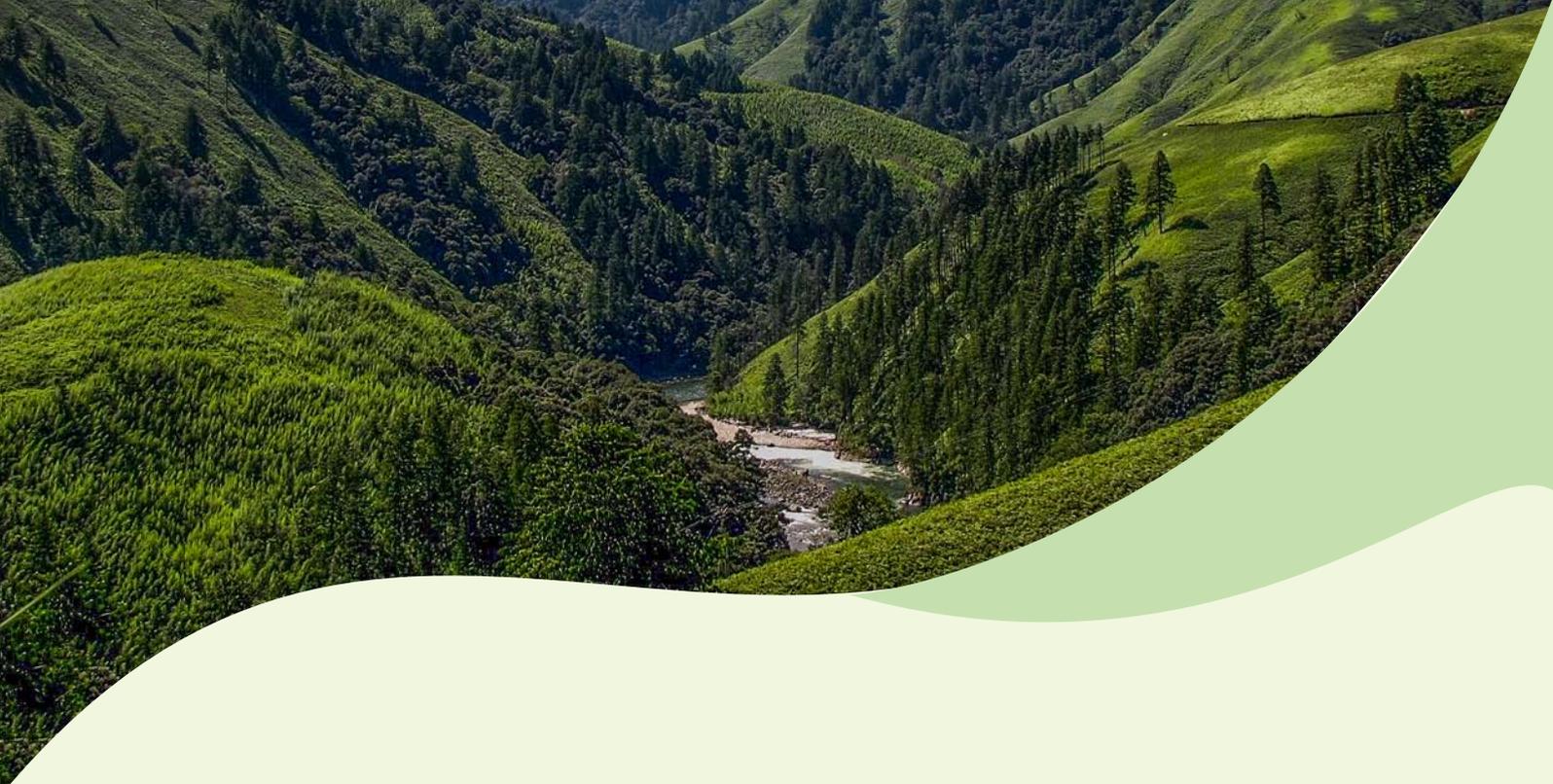
**Conceptualized and Prepared by:**

**Dr. R. S. Rawat and Dr. Shilpa Gautam**

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## Background

In India, an estimated 300 million of its total population is directly or indirectly dependent on forests, most of whom are rural poor, with little land and limited livelihood options. With such high degree of dependence on the forest, the per capita availability of forest land in India is one of the lowest. Forests in India are a significant source of sustenance for tribal and vulnerable populations living inside and on the fringes of the forests. Forests also play a critical role in supporting biodiversity which constitutes a good part of income generation for the forest fringe communities. Plant based medicinal system, the *Ayurveda*, holds its success to the vast range of medicinal plants found in India's forests.

As a result of anthropogenic pressure on natural resources, the scale and impact of land degradation and desertification are severe in the country. Degraded landscapes are more prone to invasion by invasive alien species, which compete with native species and lead to further land degradation, productivity reduction and biodiversity loss. Managing land that is undergoing degradation and desertification, is therefore a significant priority in the context of achieving India's national targets, international commitments related to Nationally Determined Contribution (NDC), Land Degradation Neutrality (LDN), and Sustainable Development Goals (SDGs) towards restoration of degraded forest lands, biodiversity conservation and climate change mitigation & adaptation.

Government of India's ambitious Green India Mission (GIM) under the National Action Plan on Climate Change recognizes that climate change phenomena will seriously affect and alter the distribution, type and quality of natural resources of the country and the associated livelihoods of local communities. GIM also acknowledges the role of forests on environmental amelioration through climate change mitigation, biodiversity conservation, food security, water security and livelihood security of forest dependent communities. GIM also puts the 'greening' in the context of climate change adaptation and mitigation, and to enhance ecosystem services like carbon sequestration and storage (in forests and other ecosystems), hydrological services and biodiversity, along with provisioning services like fuel, fodder, small timber and non-timber forest produces (NTFPs).

With an overall objective to improve forest quality, sustainable land management and NTFPs benefits for forest dependent communities in selected landscapes in Madhya Pradesh and Chhattisgarh, the World Bank is supporting Ecosystem Services Improvement Project (ESIP). This project supports the goals of GIM by demonstrating models for adaptation-based



mitigation through sustainable land and ecosystem management and livelihood benefits. One of the objectives of the project is to improve the quality and productivity of the existing forests so as to ensure sustained flows of ecosystem goods and services, and to ensure the sustainable harvesting and value addition of NTFP to provide economic benefits to forest dependent communities in selected landscapes of Chhattisgarh and Madhya Pradesh. The project has the components on (i). Strengthen capacity of government institutions in forestry and land management programs, (ii). Investments for improving forest quality in selected landscapes and (iii). Scaling up sustainable land and ecosystem management in selected landscapes.

International Workshop on 'Enhancing Ecosystem Services by Improving Forest Quality and Productivity, and SLEM Knowledge Dissemination' is being organised by Indian Council of Forestry Research and Education (ICFRE) under the World Bank funded Ecosystem Services Improvement Project at Dehradun (Uttarakhand, INDIA). The purpose for organization of an international workshop is to develop a mechanism for networking of national and international institutions/ organisations working in the field of restoration of degraded forest lands, forest carbon measurement and monitoring besides sharing of knowledges, experiences and techniques related to nursery management, plantation techniques, restoration techniques for degraded forest lands and dissemination of best practices on sustainable land and ecosystem management. Deliberation, discussion and experience sharing will be made on the following themes of the workshop:

### **THEME 1:**

#### **NURSERY MANAGEMENT, PLANTATION AND RESTORATION TECHNIQUES:**

Considerable investment has been made in developing forest nurseries by the State Forest Departments under GIM and other forestry plantation programmes. In India besides management of natural forests, considerable amount of timber is supplied from farm forestry and agroforestry. Nurseries will continue to play a vital role in promoting farm plantation and enrichment plantation of degraded forests. Proper nursery management techniques are fundamental for producing quality planting stocks which are the foundation of any planting programme. Restoration of forests will be achieved through plantations raised by quality planting stocks. The proposed theme will be focused on production of quality planting stocks, appropriate nursery techniques, management of forest nurseries and restoration techniques for restoration degraded lands.

### **THEME 2:**

#### **ENHANCING CARBON SEQUESTRATION POTENTIAL OF FORESTS AND ASSESSMENT OF FOREST CARBON STOCKS :**

Consequent upon signing of the Paris Agreement, India in its Nationally Determined Contribution (NDC) needs to create additional carbon sink of 2.5 -3 billion tonnes of CO<sub>2</sub> equivalent through additional forest and tree cover by 2030. The proposed theme will be focused on achieving this forestry sector goal of NDC through effective implementation of GIM and to develop synergies with other greening/ plantation programmes being implemented in the country. Effective protocols for measurement and assessment of forest carbon stocks needs to be developed. The outcomes of the forest carbon stocks assessment carried out by ICFRE and learning of the project partners under ESIP will also be shared.





### THEME 3:

## SLEM KNOWLEDGE SHARING AND DISSEMINATION: SHARING OF ESIP LEARNINGS, SUCCESS STORIES, BEST PRACTICES AND CASE STUDIES:

ESIP Implementing Agencies (Madhya Pradesh and Chhattisgarh State Forest Departments and ICFRE) and other State Forest Departments will share their learnings, best practices, case studies and success stories developed/ implemented under the ESIP and GIM and other projects on sustainable land and ecosystem management.

Dissemination and sharing of knowledge on Sustainable Land and Ecosystem Management (SLEM) best practices will facilitate capacity building of the stakeholders and adoption of proven, tested and cost effective SLEM best practices for achieving Land Degradation Neutrality (LDN) targets and sustainable development goals (SDGs). Knowledge sharing and dissemination on SLEM will also contribute globally in terms of capacity building of the stakeholders in restoration of degraded lands.

### ORGANISING COMMITTEE OF THE WORKSHOP

Sh. A.S. Rawat, Director General, ICFRE	: Chairman
Sh. R. K. Dogra, Dy. Director General (Admin.), ICFRE	: Member
Ms. Kanchan Devi, Director (IC) & Project Director, ESIP, ICFRE	: Member
Sh. S. P. Sharma, Addl. Principal Chief Conservator of Forests, MP	: Member
Dr. Sanjay Kumar Shukla, Inspector General of Forest, NAEB, MoEFCC	: Member
Sh. Arun Kumar Pandey, Addl. Principal Chief Conservator of Forests, CG	: Member
Dr. Rajesh Sharma, ADG (BCC), ICFRE	: Member
Dr. Shilpa Gautam, Scientist 'E' & Project Coordinator, ESIP, ICFRE	: Member
Dr. R. S. Rawat, Scientist 'E' & Project Manager, ESIP, ICFRE	: Member Secretary



## Agenda of the Workshop

Day 1: 22 March 2023	
Session – I : Inaugural Ceremony	
1400-1430 Hrs	Registration
1430-1545 Hrs	Visit to the Museums of Forest Research Institute
1545-1645 Hrs	<b>Opening Plenary</b> <ul style="list-style-type: none"> <li>• Lighting of the Lamp</li> <li>• Welcome Address by Sh. A. S. Rawat, Director General, ICFRE</li> <li>• Address by Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank</li> <li>• Address by Sh. Pravir Pandey, Additional Secretary and Financial Advisor, Ministry of Environment, Forest and Climate Change, Govt. of India</li> <li>• Address by Sh. B. K. Singh, Additional Director General of Forest (Forestry), Ministry of Environment, Forest and Climate Change Govt. of India</li> <li>• Address by Guest of Honour: Sh. Chandra Prakash Goyal, Director General of Forest &amp; Special Secretary, Ministry of Environment, Forest and Climate Change, Govt. of India</li> <li>• Address by Chief Guest: Sh. Ashwini Kumar Choubey, Hon'ble Minister of State for Environment, Forest and Climate Change</li> <li>• Vote of Thanks by Ms. Kanchan Devi, Director (IC) &amp; Project Director, ESIP, ICFRE</li> </ul>
1645 -1700 Hrs	<b>Keynote Address:</b> Rethinking Forestry for Planet People and Profit: Dr. Anupam Joshi, Senior Environmental Specialist, the World Bank, New Delhi
1700-1730 Hrs	Group Photo & High Tea
1930 onwards	Cultural Evening and Welcome Dinner (Venue: Seyfert Sarovar Premiere, Haridwar Bypass Road, Near ISBT, Dehradun)

Day 2: 23 March 2023	
Session – II : Nursery Management and Plantation Techniques for Productivity Enhancement	
0930-0955 Hrs	Nursery and plantation techniques: Dr. R.C. Dhiman, CIFOR-ICRAF
0955-1020 Hrs	Productivity enhancement of the forest plantations through planting stock improvement - ICFRE initiatives: Dr. H.S. Ginwal, Dean (Academic), Forest Research Institute Deemed to be University, Dehradun
1020-1045 Hrs	Recent advances in breeding, nursery and plantation techniques for enhancing productivity in short rotation tree species: Dr. Mohan Varghese, Senior Principal Scientist, ITC Life Sciences and Technology Centre, Bengaluru
1045-1110 Hrs	Nursery techniques for raising quality planting stock of Himalayan conifers: Dr. Sandeep Sharma, Director, ICFRE-Himalayan Forest Research Institute, Shimla
1110-1130 Hrs	Tea Break
1130-1155 Hrs	Conservation and sustainable management of Teak forest in Mekong Region: Prof. Yongyut Trisurat, Kasetsart University, Bangkok, Thailand
1155-1220 Hrs	Potential of <i>Shorea roxburghii</i> G. Don as forest plantation species and for rehabilitation of degraded areas: Dr. Ho Wai Mun, Forest Research Institute Malaysia
1220-1235 Hrs	Q&A and Discussion
Session – III: Forest Land Restoration Techniques for Improving Forest Quality and Productivity	
1235-1300 Hrs	The potential of pioneer species to the restoration programme on degraded forest: Dr. Rosdi Bin Koter, Forest Research Institute Malaysia
1300-1400 Hrs	Lunch Break

1400-1425 Hrs	Leveraging innovative tools and technologies for accelerating forest landscape restoration towards meeting 2030 Bonn Challenge commitment of India: Ms. Archana Chatterjee, Programme Manager, IUCN-India
1425-1450 Hrs	Innovative financing mechanisms for restoring mountain landscapes in the Hindu Kush Himalaya: Dr. Bhaskar S. Karky, ICIMOD, Kathmandu
1450-1515 Hrs	Forest restoration efforts of community forestry in Nepal: Success stories from Province-1, Nepal: Mr. Nabin Bhattarai, Hokkaido University, Japan
1515-1530 Hrs	Tea Break
1530-1555 Hrs	Rejuvenating landscapes - transforming lives in rural India: The Ecosystems based Adaptation: Mr. Sandeep Jadhav, Director, WOTR, Pune
1555-1620 Hrs	Sustainable Land and Ecosystem Management Opportunities in Myanmar (Case Studies on of Mangrove Ecosystem): Dr. Win Maung Aye, Assistant Director, Watershed Management Division, Forest Department, Nay Pyi Daw (Myanmar)
1620-1645 Hrs	Restoration of degraded common lands: Ms. Himani Sharma, Programme Manager, Foundation for Ecological Security, Anand
1645-1710 Hrs	Restoration of forest ecosystem services through eco-budget in Karnataka: Dr. M. Balasubramanian, Assistant Professor, Centre for Ecological Economics and Natural Resources, Institute for Social and Economic Change, Bengaluru
1710-1730 Hrs	<i>Q&amp;A and Discussion</i>

### Day 3: 24 March 2023

#### Session – IV : Enhancing Carbon Sequestration Potential and Assessment of Forest Carbon Stocks

0930-0955 Hrs	Assessment of carbon stock in India's forests: Mr. Prakash Lakhchaura, Dy. Director General, Forest Survey of India, Dehradun
0955-1020 Hrs	Role of AsiaFlux Network on measurement of carbon flux from tropical peatland: Dr. Lulie Melling, Director, Sarawak Tropical Peat Research Institute, Malaysia
1020-1045 Hrs	Role of geospatial data in carbon monitoring in Cambodia, Malaysia, Philippines and India: Dr. Ram Avtar, Associate Professor, Hokkaido University, Japan
1045-1110 Hrs	Forestry, land use and ecosystem services under the Green Climate Fund: Mr. Ben Vickers, Land Use, Forests and Ecosystems Senior Specialist, Green Climate Fund, Songdo, Incheon City, Republic of Korea ( <b>Online</b> )
1110-1125 Hrs	Tea Break
1125-1150 Hrs	Bhutan's initiative on forest carbon assessment: Mr. Dawa Zangpo, Deputy Chief Forestry Officer, Department of Forests and Parks Services, Ministry of Energy and Natural Resources, Bhutan
1150-1215 Hrs	Bangladesh initiatives on forest carbon assessment and ecosystem services valuation: Mr. Zaheer Iqbal, DCF, Bangladesh Forest Department
1215-1240 Hrs	Assessment of forest carbon stocks in Nepal: Mr. Thakur Subedi, Research Officer, Forest Research and Training Centre, Ministry of Environment and Forest, Nepal
1240-1305 Hrs	Ecosystem services resulting from the Khasi Hills Community REDD+ Project: Mr. Tambor Lyngdoh, Founding Chairman (Synjuk) Cum Community Conservator of Forest & Project Director, Khasi Hills Community REDD+ Project, Meghalaya
1305-1400 Hrs	Lunch
1400-1420 Hrs	Developing a domestic forest carbon market in India: Dr. Promode Kant, Chairman, Expert Appraisal Committee (INFRA-2), MoEFCC, Govt. of India
1420-1435 Hrs	ISRO's initiative on measurement of forest carbon exchange – status, challenges and way forward: Dr. Kiran Chand Thumaty, Scientist-'F' and Head, Forestry Resources Division, Forestry & Ecology Group, Remote Sensing Applications Area, National Remote Sensing Centre
1435-1450 Hrs	Understanding carbon exchange of western Himalayan foothill forests through Eddy Covariance measurement: Dr. Taibanganba Watham, Scientist/Engineer-SD, Indian Institute of Remote Sensing, Dehradun



1450-1500 Hrs	<i>Q&amp;A and Discussion</i>
1500-1515 Hrs	Tea Break
<b>Session - V : Sustainable Land and Ecosystem Management (SLEM) Knowledge Sharing and Dissemination</b>	
1515-1530 Hrs	Advancing knowledge sharing and capacity building for restoring forests and landscapes: Dr. Illias Animon, Forestry Officer, FAO, Bangkok ( <b>Online</b> )
1530-1545 Hrs	Enhancing ecosystem services by building climate resilient watersheds: Mrs. Neena Grewal, Project Director - Uttarakhand Decentralised Watershed Development Project-II, Uttarakhand, Dehradun
1545-1600 Hrs	Forest landscape restoration under ESIP – success stories from the state of Madhya Pradesh: Mr. S.P. Sharma, APCCF, Madhya Pradesh Forest Department, Bhopal
1600-1615 Hrs	ESIP initiatives in restoration of degraded forests in Chhattisgarh: Mr. Arun Kumar Pandey, APCCF, Chhattisgarh Forest and Climate Change Department, Raipur
1615-1630 Hrs	ESIP Learnings: Forest carbon stocks measurement and scaling up of SLEM best practices in the states of Madhya Pradesh and Chhattisgarh: Dr. R. S. Rawat, Project Manager, ESIP, ICFRE, Dehradun
1630-1640 Hrs	<i>Q&amp;A and Discussion</i>
<b>Concluding Session</b>	
1640-1725 Hrs	Wrap up and way forward
1725 - 1730 Hrs	Vote of Thanks: Dr. R. S. Rawat, Project Manager, ESIP, ICFRE



### Opening Plenary: Addresses by the High-Level Dignitaries

- Sh. Ashwini Kumar Choubey, Hon'ble Minister of State for Ministry of Environment, Forest and Climate Change, Govt. of India
- Sh. Chandra Prakash Goyal, Director General of Forest & Special Secretary, Ministry of Environment, Forest and Climate Change, Govt. of India
- Sh. A.S. Rawat, Director General, Indian Council of Forestry Research and Education
- Sh. B.K. Singh, Additional Director General of Forest (Forestry), Ministry of Environment, Forest and Climate Change, Govt. of India
- Sh. Pravir Pandey, Additional Secretary & Financial Advisor, Ministry of Environment, Forest and Climate Change, Govt. of India
- Dr. Anupam Joshi Senior Environmental Specialist, The World Bank
- Ms. Kanchan Devi, Director (IC) and PD, ESIP, ICFRE

#### Keynote Address

### RETHINKING FORESTRY FOR PLANET PEOPLE AND PROFIT

#### Dr. Anupam Joshi

*Senior Environmental Specialist, the World Bank, New Delhi*

**Brief About the Resource Person:** Dr. Anupam is a trained ecologist working in the areas of natural resources management, landscape and habitat restoration, ecosystem services, biodiversity conservation, protected area management, sustainable land management, climate change, impact assessments and rural livelihoods. With a Ph.D. from University of Delhi in 1997, he has worked with the Government of India (Planning Commission), Civil Society and Private Sector. Presently, he is working as a Senior Environmental Specialist in the World Bank. He enjoys photography, traveling and listening to music.



**Summary of the Keynote Address:** Forests have been traditionally managed for select outputs, such as, timber and non-timber products, species conservation and for their cultural values. India has managed to retain a good forest cover and maintained a robust network of protected areas, but the objective of its 1988 Forest Policy of achieving 33% forest cover remains a pipe dream. It is only recently that the forestry is seen as a potential low-cost solution for addressing multiple challenges, ranging from climate change to poverty. The time is now ripe to rethink forestry and make it an investment-friendly, ecologically secured and economically attractive sector. This would require, amongst other things, a shift from contemporary approaches in forestry to a forward looking one, where there is room for policy and institutional reforms, increased focus on ecosystem services and support for forest-dependent communities for improving and enhancing their livelihood opportunities. This achievable within one generation but the long-term benefits of a renewed forestry sector will be inter-generational.



### 1. Nursery and plantation techniques

**Dr. R. C. Dhiman**

*CIFOR-ICRAF*

**Brief About the Resource Person:** Dr. R. C. Dhiman is graduate and post graduate in Forestry from Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni (Solan, Himachal Pradesh); trained forester from Forest Research Institute & Colleges, Dehradun; and half a dozen overseas specialized trainings in forestry. He has over four decades working experience in different capacities in different organisations those include Himachal Pradesh Forest Department, Forest Research Institute, Dr. Y.S. Parmar University of Horticulture and Forestry, Wimco Limited (including Wimco Seedlings and ITC), and CIFOR-ICRAF. He has also done half a dozen international and national consultancies in forestry related disciplines.



He is widely known for his research, extension and development work on fast grown tree especially on poplars and eucalypts, commercial agroforestry, macro propagation and nursery technology. He has published over 200 papers and 11 books/bulletins; is an active member of around half a dozen professional societies; and recipient of IPC Award 2012(FAO); Dr. KG Tejwani Award (2014-15) for Agroforestry; ICFRE Award for Forestry Education 1994, and Best paper prizes from periodicals

**Summary of the Presentation:** India has a long history of raising forest plantations. Both the nursery and plantation techniques have gradually improved as a result the quality of both the planting material and field plantations have significantly improved. First regular forest plantation was raised with teak 180 years ago; other silviculturally, industrially, economically, and socially important fast-growing trees were gradually inducted in the plantation programmes. Initial approaches tried for establishing plantations include direct dibbling/sowing seed in the soil, planting nursery grown bare root and container grown seedlings, root-shoot cuttings, rhizomes, branch sets, and reallocating and transplanting old trees to another plantation sites. The current nursery techniques include use of quality reproductive material (both seed and vegetative propagules), produce quality planting material under both the bare-root and containerized seedling production systems -exhibiting higher survival, uniform growth, higher productivity and higher quality wood production for specialized end uses.

Currently vigorously growing farm plantations of selected genotypes with application of the precision silviculture using site matched mother material and other inputs is able to exploit the true potential of land and tree genetic resources and immensely helping in improving the productivity of good quality timber. Seed based plantations are now in transition to clonal forestry in which regular development and induction of new clones from long term tree improvement programs is helping in its popularity among the tree growers. Techniques and methods have been worked out for rejuvenation, induction and mass multiplication of selected mature trees and species in propagation facilities. Indian forestry still needs much focus on expanding species base in plantation forestry, expand area under traditional good quality timber species in plantation programmes, increase quality seed production from tree improvement programmes, application of biotechnological tools, and inputs on genetically modified trees. Some of the outcome from these inputs would be highly fascinating in the near future.

## 2. Productivity enhancement of the forest plantations through planting stock improvement - ICFRE Initiatives

**Dr. H.S. Ginwal**

*Scientist 'G' and Dean (Academic), FRI Deemed to be University, Dehradun*

**Brief About the Resource Person:** Dr. H.S. Ginwal is a Scientist 'G' in the field of 'Forest Genetics and Tree improvement' at Forest Research Institute Dehradun. He has 30 years' research experience as group 'A' Scientist in forestry research & education, and presently holding the position of Dean (Academic) at FRI Deemed University, Dehradun. He headed the Division of Genetics and Tree Propagation, FRI Dehradun for 11 years. Dr. Ginwal is specialized in genetic improvement of short rotation agroforestry tree species using conventional and biotechnological approaches. He has been actively associated with the Forest Departments of Uttarakhand, Haryana and Punjab in their planting stock improvement programs. He also has expertise on population and conservation genetics using DNA based tools and techniques. Dr. Ginwal obtained post graduate and Ph.D. degree in 'Forestry' from Kumaon University, Nainital. He did his Post Doctorate from the University of New Hampshire, Durham USA. He joined Indian Council of Forestry Research and Education as Scientist in the year 1992. He has published more than 130 research papers in reputed national and international journals, and has produced 13 Ph. D's as main supervisor.



**Summary of the Presentation:** Productivity of tree crops under plantations on agricultural lands in India is much lower than the same achieved in many other countries (like Brazil and Indonesia). It is a known fact that substantial gain in yield could easily be brought, if genetically improved and divergent parents are deployed and propagated clonally. The most basic determinant of productivity is quality of planting stock available. The lack of good-quality planting material is a major constraint to greater adoption of agroforestry innovations. There have been sincere efforts by ICFRE institutes in the past directed at yield improvement of forest tree species using genetic tools. Under the Planting Stock Improvement Programme, seed stands, seed production areas, seed orchards and vegetative multiplication gardens were established for several important species across the country. Genetic improvement through selection and breeding was aimed at developing varieties possessing a high level of adaptability, fast growth, tolerance / resistance to biotic and abiotic stresses and superiority in any specific economically important trait for which the species is grown in plantations. New clones and varieties were developed and released through a set of approved procedure and multi-location testing. Many of these new varieties are now widely planted by farmers, forest departments, forest development corporations and wood-based industries. Some of the varieties have been licensed to industries and private nurseries for commercial propagation and supply to the tree growers. The ICFRE institutes efforts in this direction has not only helped in expanding the area of cultivation in areas considered not suitable so far, but also helped farmers to generate additional income and also provided several environmental services like reclamation of salt-affected and waterlogged areas, protecting agricultural crops through windbreaks and shelterbelts.



### 3. Recent advances in breeding, nursery and plantation techniques for enhancing productivity in short rotation tree species

**Dr. Mohan Varghese**

*Senior Principal Scientist (Silviculture),  
 ITC Life Sciences and Technology Centre, Bengaluru*

**Brief About the Resource Person:** Dr Mohan Varghese worked as a scientist in ICFRE for 15 years and is now working as Senior Principal Scientist (Silviculture) at ITC Life Sciences and Technology Centre, Bangalore. His major research interests are “Evaluating breeding efficiency of seed orchards” and “Developing orchards to maximise gain, trait and genetic diversity”. He is currently working on enhancing productivity and pulp traits of Eucalyptus, Subabul and Casuarina. He did his post-doctoral research at the Swedish University of Agricultural Sciences, and was a visiting scientist to the University of Georgia, CSIRO-Australia, World Agroforestry Centre-Kenya, CSIR-South Africa, FuturaGene-Israel and Fibria-Brazil. He was awarded research fellowships by ITTO, AusAid, ACIAR, FAO, SIDA and International Foundation for Science. He was awarded ICFRE cash award in 2000 and IFS Jubilee cash award in 2006. He has published 25 papers and a book on “Seedling seed orchards”, and guided five students for Ph. D. in FRI University.



**Summary of the Presentation:** Genetic improvement programs are expected to generate superior planting stock compared to native stands and land races. But the actual benefit that accrues from a breeding programme is dependent on several factors like the genetic diversity, the propagation methods, and plantation management. Selection methods for increasing gain are often opposed to the conservation of diversity, that is essential for the sustainability of plantations. It is important to monitor the consequences of selection done to enhance gain. With increase in relatedness among deployed individuals, depending on deviation from random mating, the expected benefits may not be obtained.

Clones can be superior to improved seed in ideal sites, the performance can however vary in diverse sites with different climate and edaphic factors due to the genotype – environment interaction. While genetic diversity plays a significant role in determining the adaptability of genotypes to diverse environments, efficient nursery and plantation techniques are also important for ensuring the fitness and survival of the planting stock. The quality of the planting stock can vary depending on the propagation technique, and it is imperative that appropriate technology be used to develop robust plants for early establishment and survival. Fast growing short rotation trees need efficient nutrient management to sustain the productivity, by replenishing the nutrients mined out in each rotation. Interspecific hybrids are widely deployed in pulpwood plantations as they have the capacity to combine desirable traits from different species and provide several benefits over pure species. Hybrids are known to display heterosis which gives higher growth than pure species. This talk highlights the need for ensuring deployment of genetically superior planting stock, and employing the best propagation technique, along with scientific management practice for maximising and sustaining the productivity of plantations.

## 4. Nursery techniques for raising quality planting stock of Himalayan conifers

**Dr. Sandeep Sharma**

*Director, ICFRE- Himalayan Forest Research Institute, Shimla*

**Brief About the Resource Person:** Dr. Sandeep Sharma presently heading the Himalayan Forest Research Institute, Shimla as a Director In-charge. He worked as Chief Technical Advisor – Nursery under the World Bank funded Forestry Research, Education and Extension Project and was instrumental in modernizing nurseries of ICFRE Institutes. Dr. Sharma developed 3 technologies viz., macro-proliferation technique for Kutki (*Pircrorhiza kurroa*) multiplication; macro-proliferation technique for Mushakbala (*Valeriana jatamansi*) and seed technology of Himalayan Pencil Cedar (*Juniperus polycarpus*) which were duly recognized and appreciated by major stakeholders. He is developing the improved varieties of temperate medicinal plants to boost their commercial cultivation. He was also instrumental in improving the techniques for mass production of important temperate medicinal plants and other forestry species. Dr. Sharma has successfully completed 21 projects funded by various agencies. He has published 96 research papers in the journal of National and International repute. Dr. Sharma is a recipient of ICFRE Cash Award in the field of Forest Extension during the year 1996-97. He was also awarded with prestigious Brandis Prize for the valuable contribution in the Indian Forester in the field of Silviculture for the year 2004. He has guided 6 Ph.D. students for the award of doctoral degree and is also currently guiding four Ph.D. Scholars.



**Summary of the Presentation:** During the past century, the world's land base has been subject to urbanisation, weak management practices, and increasing pressure on forests to provide resources including land for an ever-growing human and livestock population all over the world. As a result, tree seedling production has become a fundamental tool for addressing afforestation, reforestation, restoration, expansion of trees outside the forest etc. Every year millions of quality seedlings are raised in nurseries all over the world for various need-based plantation programs that focus on increasing the productivity of forests. The productivity of India's forests is about 0.7 cum/ha/year, which is much below the world average of 2.1 cum/ha/year. There is a huge gap between demand and supply for both industrial & domestic wood. This gap is continuously increasing and severely affecting the very philosophy of sustainable utilization and development of natural resources. Thus, for improving the quality of India's forests, nursery techniques play a significant role in the production of quality seedlings and establishing productive plantations. Western Himalayan region is bestowed with a unique diversity of coniferous and there are 15 species of conifers belonging to 7 genera. These conifers are distributed almost the entire length of the Himalaya occupying about 6.0% of the total forest area of India. They are an important source of fuel wood, food, timber, resin, and other non-timber forest products for the local communities. The coniferous forests in Western Himalaya are threatened by illicit felling, forest fires, encroachment of forest land for agriculture, horticulture purposes, and diversion of forest land for non-forestry purposes. ICFRE-Himalayan Forest Research Institute, Shimla has successfully standardized nursery techniques of important Himalayan conifers viz., *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *P. gerardiana*, *Juniperus polycarpus*, and *Taxus wallichiana*. The techniques developed by the institute are successfully transferred to various stakeholders and are being utilized for raising quality planting stock.



## 5. Conservation and sustainable management of teak forest in Mekong Region

**Prof. Yongyut Trisurat**

*Professor of Forestry, Kasetsart University, Bangkok, Thailand*

**Brief About the Resource Person:** Prof. Yongyut Trisurat is a Professor of Forestry at Kasetsart University in Thailand. He has been active in the area of biodiversity conservation, landscape ecology, climate change and GIS for over 30 years and has been a frequent contributor to several international agencies (e.g., ADB, CIDA, DANIDA, FAO, GIZ, IPCC, IPBES, ITTO, IUCN). He was the Regional Project Manager of the ITTO Teak Project in Mekong Region and currently the Project Coordinator of the ITTO promotion of Domestic Wood Consumption in Thailand. He is now a member of Thailand's National Committee for the Conservation and Sustainable Use of Biodiversity, a member of Thailand's National World Heritage Committee, a Co-chair of the Asia-Pacific Biodiversity Observation Network (APBON), Chair of Scientific Committee for ILTER-EAP and the KBA Community representative for East-Asia Region. He was a Coordinating Lead Author of the 6<sup>th</sup> IPCC AR WGII and a Lead Author of IPBES Models and Scenarios Report.



**Summary of the Presentation:** Teak (*Tectona grandis*) is one of the most valuable tropical hardwoods in the world. Natural teak forests found in India, Lao PDR, Myanmar and Thailand and their genetic diversity are greatly declined mainly due to unsustainable forest management and agricultural expansion. The importance of teak has been recognized for over 400 years with its prominent species in the global timber trade and resulted in the expansion of teak plantations in about 70 countries throughout tropical Africa, Asia, Latin America and Oceania. However, seedlings of most plantations are from unknown sources or poor-quality materials.

With the financial support of the German Government, the International Tropical Timber Organization (ITTO) and Kasetsart University executed the Teak in Mekong Project (Cambodia, Lao PDR, Myanmar, Thailand, and Vietnam) during 2019-2022. The project provided an opportunity to build-up sustainable forest management capacities which pursue livelihood improvement and ecological significance in all participating countries. In addition, the project made full use of the existing experience and knowledge of teak resources through South-South cooperation within and outside the Mekong countries. At the end of the project, three outputs were achieved, namely: 1) the conservation of teak genetic resources, sustainable management and use of natural teak forests and market accesses of teak from legal sources; 2) strengthening of community-based and smallholders teak forest management and agroforestry systems; and 3) regional and international collaboration, information sharing and knowledge management and networking. These outputs are highly relevant to the newly introduced Bio-Circular-Green (BCG) Economic model by Thai Government and also conforms with the UN SDGs and shared at the 4<sup>th</sup> World Teak Conference 2022 in Ghana.

## 6. Potential of *Shorea roxburghii* G. Don as forest plantation species and for rehabilitation of degraded areas

**Dr. Ho Wai Mun**

*Research Officer, Forest Research Institute Malaysia*

**Brief About the Resource Person:** Dr. Ho Wai Mun is a Research Officer, Ecophysiology Branch, Forest Plantation Programme, Forestry Biotechnology Division, Forest Research Institute Malaysia. She is Ph. D. in Forest Science from Seoul National University. She has expertise in environmental management and phytoremediation, rehabilitation of degraded areas and problematic soils, carbon sequestration, plant physiology, silviculture and agroforestry. She is a recipient of Poster Award (Merit) Seminar on Reclamation, Rehabilitation and Restoration of Disturbed Sites: Planting of National and IUCN Red List Species ( 2017), the Malaysia Book of Records (Largest Man-made Forest Established on Ex-tin Mine) (2016) and Best Employee Award, International Cooperation Bureau, Korea Forest Service (2013). About 69 research papers, book chapters, proceedings, working papers etc. are in her credit.



**Summary of the Presentation:** *Shorea roxburghii* from the Dipterocarpaceae family is native to the mixed dipterocarp forest of Malaysia and is classified as 'Vulnerable' in the IUCN Red List of Threatened Species. Determine the growth and biomass accumulation in *S. roxburghii*, 2) determine suitable sites for *S. roxburghii* as a plantation species and 3) explore the possibility of *S. roxburghii* for rehabilitation of degraded or problematic sites. Results from this study will indicate the soil conditions suitable for the growth and biomass accumulation *S. roxburghii* as well as its ability to survive and grow in degraded sites.



## 7. The potential of pioneer species to the restoration programme on degraded forest

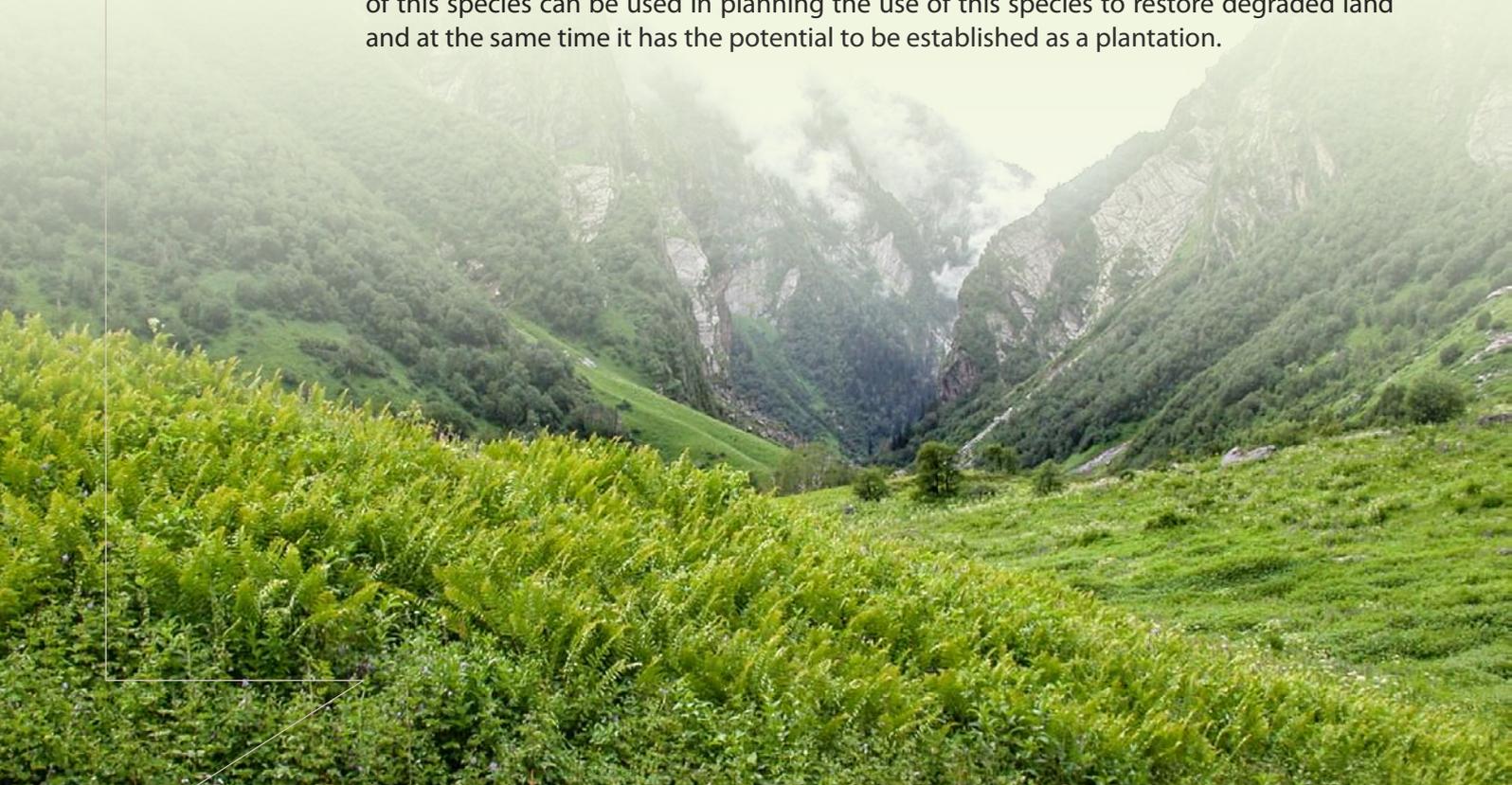
**Dr. Rosdi Bin Koter**

*Forest Research Institute Malaysia*

**Brief About the Resource Person:** Dr. Rosdi Koter, Head of Forest Plantation Programme, Forestry Biotechnology Division, FRIM, He is master in Forest Meteorology and Ph. D. in silviculture. He is involved in restoration, reclamation and rehabilitation of degraded forest using pioneer species, and development of silviculture regime on degraded forest in Peninsular Malaysia. He is associated in Herbs Research Grant Scheme under Ministry of Agriculture and Food Industries, Forest Plantation Development under Malaysian Timber Industry Board and National agroforestry development project with National Kenaf and Tobacco Board in various capacities.



**Summary of the Presentation:** The rehabilitation, reclamation and restoration of degraded areas (3RSM) program activities is one of the programs managed by the Forestry Department of Peninsular Malaysia. The program includes research on the mahang (*Macaranga tanarius*) as a pilot species in a degraded restoration project. *Macaranga tanarius* was chosen as a pilot plant because of seed availability throughout the year, high seed germination percentage and readily available seedlings. Furthermore, *M. tanarius* grows naturally at an altitude of 1,000 m above sea level. The study was initiated after realizing the importance of studying the growth and yield of fast-growing pioneer species for future forest management decisions. The data generated on the growth and potential of this species can be used in planning the use of this species to restore degraded land and at the same time it has the potential to be established as a plantation.



## 8. Leveraging innovative tools and technologies for accelerating forest landscape restoration towards meeting 2030 Bonn Challenge commitment of India

**Ms. Archana Chatterjee**

*Programme Manager, IUCN-India*

**Brief About the Resource Person:** Ms. Archana Chatterjee is leading the Programme Development and Management at IUCN India office. She has more than twenty-five years of experience with international non-governmental and UN organizations. Before joining IUCN, she was working with the UNESCO- New Delhi Office as National Project Coordinator, World Heritage Biodiversity Programme, India. She has also worked as Head, Regional Programme, WWF-India. At IUCN she has developed and worked on Transboundary ecosystems management, Agricultural landscapes in Ganga basin, mangrove conservation landscapes, Himalayan landscapes, Forest landscapes and other such challenging programmes. She holds a M.Phil. and Masters in Environmental Sciences from Jawaharlal Nehru University, New Delhi. She has also completed several international training programmes, for example, on 'Decision Making in Natural Resource Management' from Wageningen University, The Netherlands and 'Transboundary Water Management' from Sweden, Gender and environment.



**Summary of the Presentation:** Productive stable landscapes provide for a strong foundation towards country's wellbeing. In India, forests cover approximately 24% of the country's geographical area, but over the years, they have suffered from deforestation, fragmentation, and degradation due to various human activities such as logging, agriculture, and urbanization. Presently, 75% of land across the world is undergoing degradation due to human activities, and this is estimated to rise to 90% by 2050, pushing the planet towards a sixth mass extinction event.

The loss of vegetation and biodiversity, shrinking food and water supplies, loss of livelihoods and increasing urban migration is linked to an increase in desertification across landscapes in India as well. Almost 30% of the total geographic area (TGA) of the country is undergoing desertification, increasing from 96.40 million hectares (mha) to 97.85 mha between 2011-13 and 2018-19. As a signatory to the United Nations Convention to Combat Desertification (UNCCD), India has committed to achieving Land Degradation Neutrality (LDN) by 2030 – a state where amount and quality of land required to support ecosystem services and enhance food security, remains stable or increases within given ecosystems, and temporal and spatial scales. Additionally, under the Bonn Challenge, India has also committed to restoring 26 mha of land by 2030. The "Kunming-Montreal Global Biodiversity Framework" (GBF) adopted in COP15 also stresses the need for land restoration and ecological connectivity. The framework lays out 23 action-oriented global targets for urgent action over the decade to 2030 including targets for bringing loss of areas of high biodiversity importance, close to zero by 2030, restoration of at least 30% of



degraded ecosystems and conservation of at least 30% of terrestrial, inland water, and of coastal and marine areas. Over the past few years, G20 Countries have also shared their ambition to achieve a 50 per cent reduction of degraded land by 2040 on a voluntary basis and to achieve land-degradation neutrality by 2030. India has the unique opportunity, holding G20 Presidency, towards defining G20 action to combat land degradation and conserve biodiversity.

IUCN India has been identified as the nodal organisation to support the Ministry of Environment, Forest and Climate change (MoEFCC) for enhancing India's capacity on forest landscape restoration (FLR) and meeting the objectives of the Bonn Challenge. In the first phase IUCN and MoEFCC identified five states in the country – Haryana, Karnataka, Madhya Pradesh, Maharashtra, and Nagaland – as pilots for implementing IUCN's 'Restoration Opportunities Assessment Methodology' (ROAM) toolkit for identification of restoration opportunities.

Given the far-reaching and multi-sectorial implications of land use and land cover change that have huge consequences on the quality of land, restoration will require coordinated efforts of different ministries, as well as cooperation of State line departments, civil society and the private sector. ROAM, through a process that engages multiple key stakeholders, provides a flexible and affordable framework to rapidly analyse degraded areas at a national or sub-national level, prioritise areas for restoration, and identify FLR based interventions. By focusing on landscapes, as opposed to individual sites, ROAM enables the balancing of a variety of interdependent land uses across wide geographies. The principle of restoring functionality of a landscape enhances its resilience as well as productivity, helping to assuage the impacts of erosion, flooding, and climate change, along with providing a rich habitat with enhanced ecosystem services. ROAM provides policymakers with a range of strategies to choose from to help achieve this. It also incorporates widespread stakeholder engagement as a fundamental principle, so final recommendations are a product of an informed process and are therefore far more effective tools for achieving end objectives of LDN that are tailor made for local conditions. The paper will present the detailed findings from the five States on FLR opportunities and at the same time it has the potential to be established as a plantation.



## 9. Innovative financing mechanisms for restoring mountain landscapes in the Hindu Kush Himalaya

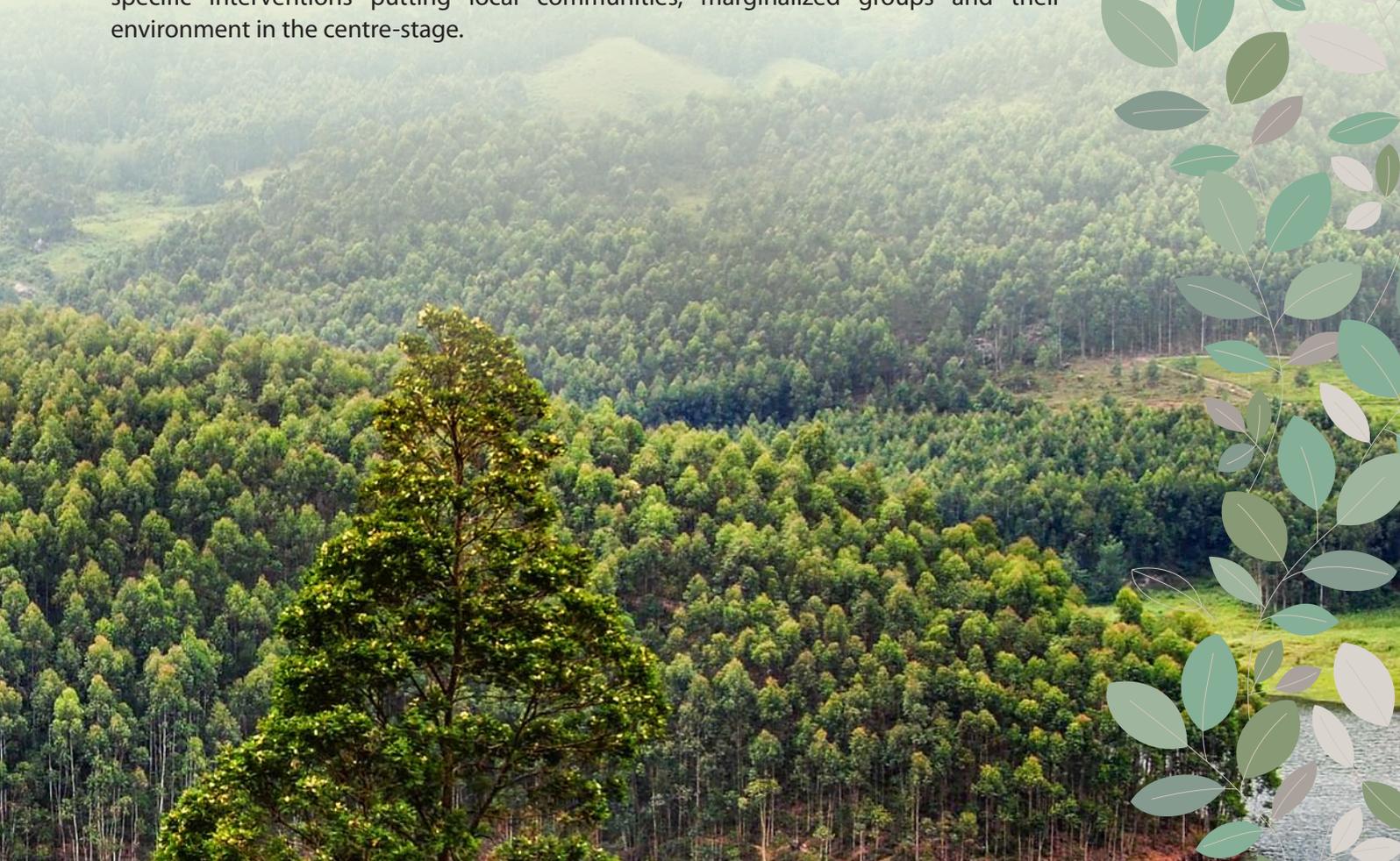
**Dr. Bhaskar Singh Karky**

*ICIMOD, Kathmandu*

**Brief About the Resource Person:** Dr. Bhaskar Singh Karky has been working as Resource Economist and Carbon Finance Specialist at ICIMOD since 2022. Before that he worked as Project Coordinator of REDD+ Himalaya Project for ICIMOD which was implemented in Bhutan, India, Myanmar and Nepal. He is an avid trekker and angler.



**Summary of the Presentation:** The Hindu Kush Himalaya region is highly vulnerable from climate change, biodiversity loss and increasing pollution that lead to costly and fatal consequences. These anthropogenic drivers have intensified the multi-hazard risk across the mountainous regions and calls for immediate mitigation and adaptation actions. Such actions require upfront finance aimed at stabilizing the slopes and maintaining a healthy ecosystem for addressing the increasing risk of disasters like flood, drought, forest fire and landslides. The presentation will discuss some of the different options of emerging financing instruments that can be used for leveraging finance for investing in the landscape so that these challenges can be mitigated by customizing specific interventions putting local communities, marginalized groups and their environment in the centre-stage.



## 10. Forest restoration efforts of community forestry in Nepal: Success stories from Province-1, Nepal

**Mr. Nabin Bhattarai**

*Hokkaido University, Japan*

**Brief About the Resource Person:** Mr. Nabin, a Ph.D. scholar at Hokkaido University, Japan, is an expert in forestry, biodiversity, climate change, REDD+, carbon finance, and greenhouse gas emissions research. He has master degree in Environmental Science from Tribhuvan University, Nepal, and has over 12 years of professional experience. As a Forest Land Restoration & REDD Research Associate at the International Centre for Integrated Mountain Development (ICIMOD), he led field-based activities for the REDD+ Himalaya project in community-managed forests of Nepal, India and Myanmar. He has over 30 publications, including scientific journals, technical papers, and policy-level documents, and led the development of sub-national REDD+ action plans in India, Myanmar, and Nepal, collaborating closely with government partners of Bhutan, India, Myanmar, and Nepal. His research interests include climate change, REDD+, forestry, governance, and biodiversity. He is an energetic team leader with excellent communication skills, able to work collaboratively and resolve problems while motivating team members to achieve personal and organizational objectives.



**Summary of the Presentation:** The United Nations has declared 2021 to 2030 as the UN Decade of Ecosystem Restoration, calling for action to restore degraded ecosystems in the fight against the climate crisis. Restoring ecosystems has benefits such as improving food and water security, increasing biodiversity, and enhancing the livelihoods of rural communities. The Bonn Challenge, launched in 2011, aimed to restore 150 million hectares of degraded and deforested landscapes by 2020 and 350 million hectares by 2030.

Nepal's sustainable forest management efforts are notable for their people-centric approach, which places local communities at the centre of forest management policy. Restoring forests goes beyond just planting trees; it restores the entire landscape, providing additional ecosystem services over time to a wider population. This publication celebrates the UN Decade of Ecosystem Restoration by compiling successful conservation practices employed by 14 distinct Community Forest User Groups (CFUGs) in Province 1, in the Eastern Himalayan region of Nepal.

The CFUGs, formed by local populations who depend on forest resources, manage the forest and contribute to community development through financial aid and loans to students, poor families, sports clubs, and local infrastructure. The CFUGs face challenges such as invasive species, government taxation, drying wetlands, illegal logging, and human-wildlife conflict. Good practices include promoting alternatives to firewood, ecotourism, managing income and funds with transparency, and including minority groups in forest governance. Each CFUG's restoration effort is customized to the specific context in question, requiring a combination of scientific approaches and indigenous knowledge.

One prime example of community-led success is the river forest corridor development of the Mawa Khola to prevent disastrous floods. Overall, community-led efforts in Province 1 of Nepal have been highly effective in ecosystem restoration, and many of these successful and sustainable practices can be replicated and scaled up, contributing to the UN Decade of Ecosystem Restoration.

## 11. Rejuvenating landscapes - transforming lives in rural India: The Ecosystems based Adaptation

**Sh. Sandeep Jadhav**

*Director, WOTR, Pune*

**Brief About the Resource Person: Mr. Sandip Jadhav** has dedicated almost 30 years of his career to working with non-profit organizations, government agencies and corporate social responsibility. He has a wealth of experience in areas such as community-led watershed development, rural development, natural resource management, building effective organisations, training, project planning and management, and monitoring and evaluating program effectiveness. One notable accomplishment was his involvement in the Indo-German Watershed Development Program, which is widely recognized as one of the most successful watershed initiatives in India and around the world. Sandip holds a degree in agricultural engineering with post-graduation in economics, and has held leadership roles at organisations such as the Lupin Foundation and MAVIM. For over 25 years, he has been closely associated with WOTR, currently serving as its Director in Pune and overlooks projects in the states of Madhya Pradesh, Chhattisgarh, Odisha, Jharkhand and Rajasthan.



**Summary of the Presentation:** WOTR believes that ecosystems degradation, climate change, low agriculture productivity and over-dependence on agriculture are root causes of rural poverty in rain dependent rural India. WOTR's central theme of interventions remained land and water management since last 3 decades that includes integrated watershed development, water stewardship and governance, ecosystems and biodiversity conservation. Once the resource base is rejuvenated, other themes such as agriculture, livelihoods, health, sanitation & nutrition and women empowerment become integral part of poverty eradication. The interventions in agriculture component are focused on agriculture productivity and meteorology, soil health and water management, farmers' capacitation and market linkages. Other initiatives of WOTR include micro-enterprise development, nutrition, drinking water and sanitation, women self-help management and drudgery reduction and gender roles in development.

Ecosystems based Adaptation (EbA) is a promising solution to build the resilience and reduce the vulnerability of local communities to climate change (CC) while conserving the natural and biological resources (ecosystem services - ESS) on which they depend. The EbA is a 3-pronged approach: healthy ESS & biodiversity, people adapt to CC and participatory governance. To quote an example, EbA in Bhojdari village over 20 years has intensified agriculture by 64%, vegetative cover by 39% and NDVI by 83%. In a cluster from Dhule district, watershed management has helped bringing 81.11% of total area under permissible soil loss limit (<5 t/ha/yr) as compared to 60.57% in pre-project situation between 2009 and 2016. The cost inaction per household was estimated to be Rs. 1,17,791 in rain-shadow upper catchment region. WOTR's work directly contributes to 9 of the 17 SDGs and is aligned with other key international conventions; Land Degradation Neutrality, Paris Agreement on Climate Change, Sendai Framework on Disaster Risk Reduction. The tools and techniques evolved through WOTR's initiatives are participatory net planning, public private civil society partnership (PPCP) model for watershed through MGNREGA, community driven vulnerability evaluation- program design (CoDrIVE-PD), CoDrIVE Visual Integrator (3-D modelling), crop-weather advisories, etc.



## 12. Sustainable land and ecosystem management opportunities in Myanmar (Case studies on of Mangrove Ecosystem)

**Dr. Win Maung Aye**

*Assistant Director, Watershed Management Division,  
 Forest Department, Nay Pyi Daw (Myanmar)*

**Brief About the Resource Person:** Dr. Win Maung Aye is presently working in the Watershed Management Division of the Forest Department of Myanmar. He is responsible for the inland watershed forests and coastal watershed forests management in Myanmar. During his governmental staff life from 2006 to present, he emphasis on the mangrove ecosystem management and rural development in Myanmar. As a fulfilment for his Ph.D., he studied the coexistence of mangrove ecosystems and local communities in Myanmar. He is also currently participated in research activities on agroforestry, climate change, mangrove management, watershed and water resources management, transboundary resources conservation and so on.



**Summary of the Presentation:** Myanmar is blessed with high forest cover of 42.19% of the country's total area. The forests are providing the basic needs and livelihoods of 70% of the country's rural population and the forestry sector is also playing a pivotal role in sustainable development of the nation. However, forests are increasingly threatened by a wide range of pressures, including deforestation, land-use change, agricultural expansion, invasive alien species, and climate change impacts. The government of Myanmar is fully committed to climate change mitigation, biodiversity conservation, combating desertification, sustainable forest management, restoration of degraded forest ecosystems and so on. Based on the different social, geographical and forest conditions, Myanmar has numerous sustainable land and ecosystem management opportunities in order to achieve its national targets and commitments for natural resources and environmental conservation and sustainable development. Therefore, firstly, the overview of the Myanmar's SLEM opportunities are introduced and the specific case studies of SLEM opportunities of an important ecosystem for climate change sector, mangroves, are presented. From three different social and mangroves ecosystem conditions (natural mangroves with Moken community, local conserved mangroves with Karen community and mangroves paddy fields with Mon community), SLEM opportunities are also highlighted in this presentation.

## 13. Restoration of degraded common lands

**Ms. Himani Sharma**

*Programme Manager, Foundation for Ecological Security*

**Brief About the Resource Person:** Ms. Himani Sharma has more than a decade of experience focusing on action research for improved natural resource governance. She has contributed in different functional roles such as long-term socio-ecological monitoring, building evidence of the significance of Commons as resources and governance systems, and developing and applying experiential learning methods and tools that can help strengthen collective action on governance of shared natural resources. She holds a Master's degree in Forestry from Forest Research Institute, Dehradun.



**Summary of the Presentation:** Common lands including community forests, pastures and 'wastelands' constitute 25 percent of the geographical area of India. Commons serve critical ecological functions (and services) contributing to carbon sequestration, biodiversity conservation and maintenance of hydrological and nutrient cycles. They meet critical livelihood needs of food, fodder, medicine, firewood, small timber etc. Despite the ecological, social and economic significance, Commons have been neglected due to unfavourable property rights and weak institutional arrangements for local management and governance resulting in widespread degradation. Deforestation and land degradation have severely affected the health of systemic drivers – soil, moisture, nutrients, biomass, and biodiversity. Besides causing these serious environmental problems, degradation of Commons negatively impacts the basic livelihood of more than 300 million rural poor in India and contributing to poverty, conflict, corruption and limited economic growth. In this context, Foundation for Ecological Security (FES), a non-governmental organization (NGOs) working across 12 states in India, helps decentralise the top-heavy approach to environmental management and demonstrates the strength of local communities to collaborate and deploy local knowledge to cost effectively manage natural resources, Commons in particular.

The presentation by FES aims to share reflections and insights from our experiences of working on the inter-connected issues of tenure, local governance and restoration of degraded landscapes for improved health of ecosystems and resilient livelihoods. The presentation will highlight the landscape level approach and the fundamental dimensions of our work at village as well as landscape level. We will share about FES's experiences working with community institutions, government and civil society actors to enable communities secure their rights on Commons, strengthen collective action and enhancing investments on restoration; the ecological processes, methods and the best practices in restoration of common lands. Application of tools and technology to enable data and evidence-based decision making at scale and impact of work in terms of improved vegetative cover and carbon sequestration, improved environmental services and resilience of agro-ecosystems, stronger local stewardship, sustainable land and water management addressing land degradation.



## 14. Restoration of forest ecosystem services through eco-budget in Karnataka

**Dr. M. Balasubramanian**

*Assistant Professor, Centre for Ecological Economics and Natural Resources,  
 Institute for Social and Economic Change, Bengaluru*

**Brief About the Resource Person:** Dr M Balasubramanian is an Assistant Professor at the Centre for Ecological Economics and Natural Resources of the Institute for Social and Economic Change (ISEC), Bangalore. He is the visiting faculty in the University of Tammusat, Thailand, from January 2017 and Central University of Tamil Nadu from January to March 2015. His main research interest's economics of forest ecosystem services link with human well-being, climate change, biodiversity conservation. Currently, he is the state level member of Eco-Budget in Karnataka. He has published research papers in refereed journals including Nature Communications, The Lancet Planetary Health, Global Ecology and Conservation, Environmental Monitoring and Assessment, Frontier in Ecology and Evaluation and Economic and Political Weekly. He has received major research project grants from Bill & Melinda Gates Foundation and the Department of Biotechnology, Ministry of Human Resource Development and State Forest Department.



**Summary of the Presentation:** The forest ecosystem plays a vital role in the advancement of human beings as well as protecting their environment. India has committed to create an additional carbon sink of 2.5 to 3.0 billion tonnes through additional forest and tree cover by 2030. In this regard, Karnataka has been identified as the second potential state for an additional carbon sink of 112.95 million tonnes CO<sub>2</sub> eq by 2030. Given the above facts, the economic loss assessment of forest ecosystem services can help in understanding the contribution of forests to the state economy and societal welfare. It will also help in better understanding of how anthropogenic activities affect forest ecosystem and its services, thereby, enhancing investment in development programmes for the forestry sector by increasing additional carbon sink and other services such as timber production, water conservation etc., to achieve Sustainable Development Goals. The valuation system to assess the losses for Karnataka state has been done based on this SEEA-EA framework which considers opening stock, changes in stock and closing stock, especially for timber resources during the past five years. The data is sourced from the annual reports of the Karnataka Forest Department, Forest Survey of India and other published papers. Forest ecosystem services such as carbon sequestration, air purification, nontimber forest products and pollination services have been calculated for the past five years based on the SEEA-EA framework. The calculated loss of timber provisioning services is estimated at Rs 988.73 crore, carbon sequestration services at Rs .2188.90 crore, soil erosion prevention services at Rs. 499.47 crore and pollination services at Rs. 23.12 crore, in total during the past five years. The losses to forest ecosystem services are estimated at Rs. 3831.28 crore. Therefore, the loss of value of forest ecosystem services should be properly accounted for and compensated for making good of it.

## 15. Assessment of carbon stock in India's forests

**Mr. Prakash Lakhchaura**

*Dy. Director General, Forest Survey of India, Dehradun*

**Brief About the Resource Person:** Mr. Prakash Lakhchaura belongs to Indian Statistical Service of 1998 batch and presently working as Deputy Director General, Forest Survey of India. He worked as Assistant Directors in Ministry of Statistics and Programme Implementation for about 4 years. Thereafter, he worked in FSI for about 15 years in different capacities. While working at FSI he has contributed significantly in developing of sampling design for National Forest Inventory, conducting special study for NATCOM-II, developing estimation protocols for NFI data, estimation of the carbon stock in country's forests for reporting to NATCOM and Global Forest Resource Assessment. He has attended several national and international meetings/workshops related to National Forest Inventory and carbon stock estimation. He has also worked in Department of Expenditure, Ministry of Finance for about one year and contributed significantly in finalization of EFC Memos of many ministries.



**Summary of the Presentation:** Climate change has become a serious threat to the environment and the quality of life all over the world. Forests play very important role in mitigation and adaptation to climate change. Forests are considered as reservoir, sink and source of carbon. Carbon sequestration by forests has attracted much interest globally as it is a relatively inexpensive means of mitigation of climate change. FSI has been estimating carbon stock in the country's forests for various NATCOMs and providing valuable inputs to the Ministry of Environment, Forest and Climate Change in preparation of GHG inventory of the country. FSI published a separate report on 'Carbon stock in India's Forests' in the year 2011. A separate chapter on carbon stock was given first time in India State of Forest Report 2011 highlighting the results of Second National Communication. Since then, the information on total carbon stock and change with respect to previous assessment is a part of successive ISFRs. With the launch of National Forest Inventory (NFI), FSI has been estimating growing stock in both forest and TOF since 2003. Subsequently suitable modifications were also made in the plot design to collect information required for calculation of the carbon stock in different carbon pools. The NFI design was changed in the year 2016 again by switching over from district based to grid-based design to meet the data needs at the national and international levels. In addition, the information on forest cover in different forest types is used for the estimation of carbon stock.



## 16 . Role of AsiaFlux Network on measurement of carbon flux from tropical peatland

**Dr. Lulie Melling**

*Director, Sarawak Tropical Peat Research Institute, Malaysia*

**Brief About the Resource Person:** Dr Lulie Melling is a renowned expert in tropical peat research. Her academic journey began with a Bachelor's degree in Geography from the University of Malaya, Kuala Lumpur, which provided a strong foundation for her later studies. However, it was during her Master's degree at the University of Reading, UK, in 1995 that she developed a profound interest in peat soils. Dr Melling's research interests led her to pursue a PhD at Hokkaido University, Japan, where she earned her doctorate in 2005. Her dissertation focused on greenhouse gas fluxes from tropical peatlands in Sarawak, Malaysia, which marked an important contribution to tropical peat research.



In 2008, she is the founding member and director of the Sarawak Tropical Peat Research Unit, now the Sarawak Tropical Peat Research Institute (TROPI). She has been working on several research projects involving peatland ecosystems, developing strategies for sustainable peatland management, and working with local communities to promote environmental sustainability. Currently, her research focuses on greenhouse gas fluxes from tropical peatlands using high-end research technologies such as eddy covariance coupled with the Internet of Things. She served on various committees and advisory roles, such as the National Committee of the International Peat Society for 2010-2022, President of the Malaysian Peat Society and the Asia Flux Science Steering Committee member of the Asia Flux Network for 2012-2024, mention a few. Throughout her career, she has received multiple awards for her contributions to the field, such as the Anak Sarawak Award, the Excellent Service Award, the Most Inspiring Women Award, the Anak Sarawak Outstanding Achievement Award, Young Peatland Scientist Award and Asia Flux Fellowship Award. Overall, Lulie Melling's work has been instrumental in advancing our understanding of tropical peatlands and their role in the global ecology. Her contributions to the field have advanced scientific knowledge and helped promote sustainable development and conservation efforts in Malaysia and beyond.

**Summary of the Presentation:** Tropical peatlands are a unique wetland ecosystem characterized by thick layers of organic matter that have accumulated over thousands of years under waterlogged and acidic conditions. They are found in different parts of the world, including Southeast Asia, Central Africa, and South America, and are vital for carbon storage. However, in Southeast Asia, human activities like deforestation and land use changes, including drainage, have triggered the decomposition of this organic matter leading to the release of greenhouse gases such as carbon dioxide and methane, which contribute significantly to climate change. To better understand the tropical peatland ecosystem for development, management, and conservation, in 2010, Sarawak had established three 40- meter Eddy Flux towers with the technical and scientific support of the Asia Flux Network. The Asia Flux Network provided a collaborative platform

for researchers to share measurement techniques, data analysis methods, and best practices. It also provided capacity building and training through various workshops and training programs. With the support of the Asia Flux Network, scientific knowledge on carbon flux from tropical peatlands has advanced significantly, improving the accuracy and consistency of carbon flux measurements and identifying factors that may affect the peatland's carbon balance. This new understanding would then be able to develop strategies to enhance tropical peatland carbon sequestration, management, and conservation. By working together, researchers can use this knowledge to develop more effective approaches to conserve and increase the potential for carbon sequestration of these critical ecosystems and reduce the impact of human activities on them..



## 17. Role of geospatial data in carbon monitoring in Cambodia, Malaysia, Philippines and India

**Dr Ram Avtar**

*Associate Professor, Hokkaido University, Japan*

**Brief About the Resource Person:** Dr. Ram Avtar is working as an Associate Professor at the Faculty of Environmental Earth Science, Hokkaido University, Japan and Director of the Global Land Programme (GLP) Japan Nodal Office. He actively contributes to study land systems and co-design solutions for global sustainability as a part of the GLP programme. He holds a master's degree in Environmental Science from Jawaharlal Nehru University, New Delhi, India and a doctorate in Civil Engineering from the University of Tokyo, Japan. He has developed methods for mapping natural resources using multi-sensor remote sensing techniques and scenario analysis for sustainable management of these resources. Currently, He is working on the synergistic use of remote sensing and Unmanned Aerial Vehicles (UAVs) techniques to monitor the environment more precisely to solve environmental issues from a global to local scale. The ultimate goal of his research is to use transdisciplinary research methods to promote research on vulnerability, resilience and sustainability.



**Summary of the Presentation:** The latest sixth Assessment Report of Intergovernmental Panel on Climate Change highlighted the role of digital technologies to mitigate climate change and to achieve several SDGs. Digital technology will be able to support decarbonization only if appropriately governed. The applications of geospatial data and advanced machine learning algorithms play an important role in monitoring forests biophysical parameters accurately. This study investigates the potential of Phased Array-type L-band Synthetic Aperture Radar (PALSAR) satellite data to estimate forest aboveground biomass (AGB) in Cambodia and the Philippines. The results of this study are useful to overcome the limitations of clouds in tropical forests. Canopy height estimation using TanDEM-X InSAR methods in Malaysia using SINC model. Machine Learning Methods of Symbolic Regression & Random Forest were utilized to establish a relationship between extracted biophysical variables with ground truth data. This study will enable local policymakers to better implement the Paris agreement by relying on updated information about forest biophysical parameters as well as implementation of forest management practices for REDD+ assessment.

## 18. Forestry, land use and ecosystem services under the Green Climate Fund

### Mr. Ben Vickers

*Land Use, Forests and Ecosystems Senior Specialist,  
Green Climate Fund, Incheon, South Korea (Online)*

**Brief About the Resource Person:** Ben Vickers has 25 years of experience in the fields of forestry and rural development. Since obtaining a MSc in Forestry from the University of Oxford, he has lived in Nepal, Viet Nam, India and Thailand, working throughout Asia, the Pacific and sub-Saharan Africa. Since 2007 he has focused on supporting the integration of the forest sector into national climate change mitigation and adaptation policies and strategies, in particular through REDD+. From 2012 he coordinated the work of FAO on REDD+ in the Asia-Pacific region, including through the UN-REDD Programme, the Forest Carbon Partnership Facility of the World Bank, and the development and initiation of projects under the Green Climate Fund (GCF). In February 2021 he joined the GCF Secretariat in Korea as a Land Use, Forests and Ecosystems Senior Specialist.



**Summary of the Presentation:** The Green Climate Fund (GCF) is the largest climate fund, instituted by the UN Framework Convention on Climate Change (UNFCCC) as a dedicated channel for climate finance to flow from industrialised countries to developing countries in support of the Paris Agreement goals. By end 2022, the GCF had approved about US\$11 billion of investment in over 200 projects and programmes worldwide, of which 84 include components in the sectors of forestry, land use and ecosystem services. The presentation provides an introduction to the GCF and its approach to climate finance, a sample of the forestry and ecosystems portfolio, priorities for further expansion of this portfolio and challenges in monitoring impact in terms of both mitigation of, and adaptation to, climate change.



## 19. Bhutan's initiative on forest carbon assessment

### Mr. Dawa Zangpo

*Deputy Chief Forestry Officer, Department of Forests and Parks Services,  
 Ministry of Energy and Natural Resources, Bhutan*

**Brief About the Resource Person:** Mr. Dawa Zangpo is a Bachelors of Forestry from India and Masters in Sustainable Forest and Nature Management with specialization in use of Geographic Information Systems and remote sensing for forestry cover change analysis from Denmark and Germany. He has joined the Department of Forest and Park Services, Ministry of Energy and Natural Resources in 2010. Currently, serving as Deputy Chief Forestry Officer with the Forest Monitoring and Information Division. As part of the National Forest Information and GIS section of the Division, he provides geospatial and remote sensing services for the Department.



**Summary of the Presentation:** Bhutan with the forest cover of more than 70% is a high forest low deforestation nation situated in the Eastern Himalayas, sandwiched between India and China. As enshrined in the country's constitution, the Department of Forests and Park Services, Ministry of Energy and Natural Resources is mandated to maintain 60% percent of its land area under forest cover for all times to come. 51.44 % of the country's area is under the protected area network and only about 7% of forest managed for timber. In 2009, Bhutan pledged to remain carbon neutral at COP15 of UNFCCC, in Copenhagen. Since 1974-2010 numerous forest resource assessment exercises have been conducted using mostly remote sensing-based and only one field-based methods. However, the first National Forest Inventory (NFI) was undertaken from 2009-2016. The NFI was initiated to meet the objectives viz. to maintain 60% percent of its land area under forest cover, to sustainably manage our forests for sustainable development, to establish an institution that will enable periodic inventory and monitoring of changes over time, to contribute to the commitment to remain carbon neutral and to help in participation for REDD/REDD+ mechanism (for development of emission factors and national forest monitoring system). Based on the analysis from the 1st NFI data, Bhutan has a total forest carbon stock of 645.12 million tonnes (i.e., biomass carbon equivalent to 457.27 and soil organic carbon equivalent to 187.85 million tonnes). Bhutan submitted its Forest Reference Emission Level (FREL) and Forest Reference Level (FRL) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2020. Currently, we have completed the field data collection for the second NFI and is in the process on analysing the data. The results from the second NFI will provide information on changes in forest carbon stock of Bhutan.

## 20. Bangladesh initiatives on forest carbon assessment and ecosystem services valuation

**Mr. Md. Zaheer Iqbal**

*DCF, Bangladesh Forest Department*

**Brief About the Resource Person:** Mr. Md. Zaheer Iqbal working as Deputy Conservator of Forests in Bangladesh Forest Department since 1993. He is a forestry graduate from University of Chittagong, and Masters of Science in Remote Sensing & GIS from Asian Institute of Technology, Thailand. During beginning of his service, he has worked in different social forestry divisions under Bangladesh Forest Department. Since 2006, he is working in Resource Information and Management System of Bangladesh Forest Department. This unit prepares and update geospatial dataset, land cover maps, forest inventory data and other datasets.



He was involved in designing, data collection, data processing and analysis of Sundarban Carbon Inventory 2009-10. We completed comprehensive tree cover monitoring of Bangladesh 2000-14 with technical assistance of University of Maryland. The first ever National Forest Inventory of Bangladesh (2016 to June 2019) has been completed under his direct supervision and coordination.

**Summary of the Presentation:** Bangladesh Forest Department has taken several initiatives for carbon assessment such as Sundarbans carbon assessment 2009-10, Carbon assessment of protected areas, carbon assessment under 1<sup>st</sup> National Forest Inventory and 2<sup>nd</sup> National Forest Inventory and carbon assessment of urban trees. Case studies on valuation of ecosystem services and future plans are highlighted.



## 21. Assessment of forest carbon stocks in Nepal

**Mr. Thakur Subedi**

*Research Officer, Forest Research and Training Centre,  
Ministry of Environment and Forest, Nepal*

**Brief About the Resource Person:** Mr. Thakur Subedi is currently working as a Research Officer, Forest Research and Training Centre, Ministry of Environment and Forest, Nepal. He has master degree in natural resource management. He has professional experience of more than 25 years. His research interests include climate change, forest biometry, forest management and biodiversity.



**Summary of the Presentation:** Nepal as a Party to UN Framework Convention on Climate Change, Kyoto Protocol and Paris Agreement, is committed to mitigate and adapt to the adverse impacts of climate change. Nepal has made several policy and institutional mechanism to achieve the goals as per its international commitments. Nepal is a pioneer country to implement REDD+ program. Forest Research and Training Center (FRTC) is one of the Governmental entity responsible for carbon assessment and the central agency for monitoring, reporting and verification (MRV) under REDD+ program.

Forests represent the largest land use in Nepal, covering 42% of the total land area, whereas other wooded land covers 3%. Nepal has periodically conducted forest cover mapping and national forest inventory since 1970s. Nepal has National Forest Reference Level (FRL) and national forest monitoring system (NFMS). As part of the NFMS, FRTC established almost 2250 permanent forest sample plots throughout the country. Nation-wide forest resource assessment (FRA; 2010 - 2015) assessed the forest carbon using two-phase stratified systematic sampling with four concentric circular sample plots (CCSP) to measure the trees of different sizes. Species specific allometric equation is used for volume calculation and that was converted to biomass by multiplying it with its wood density. Branch and foliage biomass are calculated using specific ratio to the stem volume. The total carbon stock in the forest was estimated as 1,054.97 million tonnes, with an average stock of 176.95 t/ha. Nepal is now preparing MRV report of the TAL area for the Carbon Fund of the FCPF/World Bank as part of the agreement. Nepal is currently working on to develop volume and biomass allometric equations for major trees species. This paper will discuss Nepal's efforts in conducting national land cover monitoring system, forest carbon assessment, MRV of emission reduction program, and allometric equation development for major tree and shrub species in Nepal.

## 22. Ecosystem services resulting from the Khasi Hills Community REDD+ Project

### Sh. Tambor Lyngdoh

*Founding Chairman (Synjuk) Cum Community Conservator of Forest & Project Director,  
Khasi Hills Community REDD+ Project*

**Brief About the Resource Person:** Mr. Tambor Lyngdoh is a Founding Chairman, Synjuk Cum Community Conservator of Forest and Project Director Khasi Hills Community REDD plus Project. He has over two and a half decades of experience in conservation efforts. From 1996-2011, acting as the Secretary for his local governing agency (Hima), he initiated the revival of the nearby sacred grove, introduced eco-tourism to the area since 1996, and participated in forest preservation while actively drawing others in to form his current organization, Ka Synjuk ki Hima Arliang Wah Umiam Mawphlang Welfare Society (Synjuk).



He has headed the Community-Based Biodiversity Conservation Project as the President of the Village Forest Council since 2001. He is a recipient of the 'Eastern Himalayan Conservation Award 2018', the NatWest Earth Heroes 'Green Warrior Award 2020', 'The Wetlands Champions 2022' by the Ministry of Environment, Forest and Climate Change, Government of India, 'the Meghalaya State Excellence Award 2021. His pursuits are in sustainable tourism, sacred grove preservation, wildlife conservation, and community development.

**Summary of the Presentation:** The Synjuk organisation implemented the first UN REDD+ (Reducing Emissions from Deforestation and Degradation) project in India, effectively uniting ten indigenous governments to protect and conserve community forests. This REDD+ project is one of the few in Asia that is managed by indigenous communities. In tandem, he has mobilized awareness through women's micro-finance groups, farmer groups, and youth in 86 and more villages to promote the conservation measures. By providing alternatives to forest timber products, the 7700 households in the project area earn income while protecting forest habitat. The presentation is highlighting the Community Mobilization, Forestry and Socio-economic Activities (biodiversity, hydrology, transition to alternative livelihoods, and monitoring) and Technical Aspects including project design, technical specifications, and verification.



## 23. Developing a domestic forest carbon market in India

**Dr. Promode Kant**

*Chairman, MoEFCC Expert Appraisal Committee (INFRA-2)*

**Brief About the Resource Person:** Dr. Promode Kant, Chairman, Expert Appraisal Committee (INFRA 2), Ministry of Environment, Forest and Climate Change, Government of India, is a former member of the Indian Forest Service with long experience in the field of forestry and climate change. He was the Chairman of the ICFRE's Committee for Establishing the Domestic Forest Carbon Market in India and will be presenting a paper based on the Committee's findings.



**Summary of the Presentation:** IPCC estimates that limiting warming to 1.5°C implies reaching net zero CO<sub>2</sub> emissions globally well before 2050 which would be achievable only by massively removing CO<sub>2</sub> from the atmosphere by sequestering it in forests and in trees outside forests. For this to happen at a fast pace it is important that millions of farmers and small land owners should take active part in planting trees and managing them well but very low economic returns from forestry goods like wood and non-timber forest products are a major handicap in motivating them. If a value can be placed on the climate change mitigation services offered by forests and trees and realized through a market dedicated to this purpose then the economic returns from forestry can be enhanced substantially. A mandatory carbon market under the Kyoto Protocol and a few voluntary carbon markets have been established over the past three decades but with very limited success on account of the extremely high costs involved. This paper presents the work by a Committee formed by ICFRE to establish domestic forest carbon market in India which responds to the situation in India in the light of international experiences gained around the world.



## 24. ISRO's initiative on measurement of forest carbon exchange – status, challenges and way forward

**Dr. Kiran Chand Thumaty**

*Scientist-'F' and Head, Forestry Resources Division,  
Forestry & Ecology Group, Remote Sensing Applications Area, National Remote Sensing Centre*

**Brief About the Resource Person:** Dr Kiran Chand Thumaty is currently Scientist-'F' and Head, Forestry Resources Division, Forestry & Ecology Group, Remote Sensing Applications Area, National Remote Sensing Centre. He has Master degree in Environmental Sciences from Andhra University, Visakhapatnam and Ph. D. in environmental remote sensing applications. Since 2007, he is working as a scientist in National Remote Sensing Centre (ISRO), in the area of remote sensing applications in forestry & ecology. His research interests are (1) remote sensing of fires, (2) open biomass burning and emissions inventory, (3) forest carbon fluxes and carbon sequestration and (4) retrieval of forest biophysical parameters using remote sensing. His contributions have resulted in more than 40 research publications in national and international journals and in more than 20 proceedings in international and national conferences/ workshops



**Summary of the Presentation:** Dr Kiran Chand Thumaty is currently Scientist-'F' and Head, Forestry Resources Division, Forestry & Ecology Group, Remote Sensing Applications Area, National Remote Sensing Centre. He has Master degree in Environmental Sciences from Andhra University, Visakhapatnam and Ph. D. in environmental remote sensing applications. Since 2007, he is working as a scientist in National Remote Sensing Centre (ISRO), in the area of remote sensing applications in forestry & ecology. His research interests are (1) remote sensing of fires, (2) open biomass burning and emissions inventory, (3) forest carbon fluxes and carbon sequestration and (4) retrieval of forest biophysical parameters using remote sensing. His contributions have resulted in more than 40 research publications in national and international journals and in more than 20 proceedings in international and national conferences/ workshops.



## 25. Understanding carbon exchange of western Himalayan foothill forests through Eddy Covariance measurement

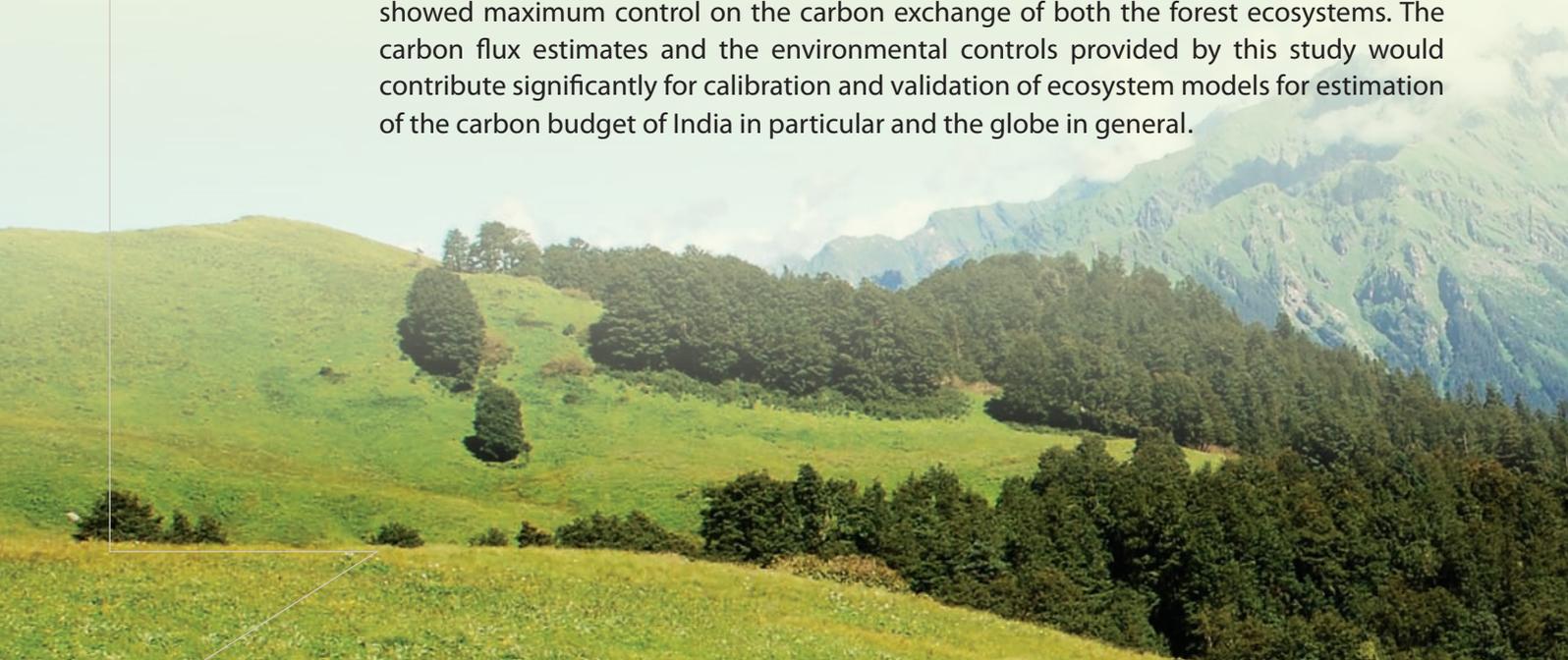
**Dr. Taibanganba Watham**

*Scientist/Engineer-SD, Indian Institute of Remote Sensing, Dehradun*

**Brief About the Resource Person:** Dr. Taibanganba Watham is M.Sc. (Forestry) from Mizoram University, Aizawl, Mizoram and the Ph.D. Degree in Forest Ecology and Environment from Forest Research Institute, Dehradun, India. He joined ISRO in 2018. Currently, he is Scientist/Engineer-SD in Forestry and Ecology Department, Indian Institute of Remote Sensing, Dehradun, India. His research interests include Eddy Covariance measurement, forest carbon, integration of ground measurement and remote sensing data.



**Summary of the Presentation:** The forests play significant role in regulating the carbon and water exchange between atmosphere and biosphere. With climate change and global warming, the ability to monitor the carbon exchange at regional to global scales is of increasing interest. Accurate quantification of forests carbon fluxes can provide deeper understanding on biosphere-atmosphere carbon interaction and can guide climate policy makers in mitigation strategy planning. However, the carbon flux characteristics (Gross Primary Productivity, Net Ecosystem Exchange, and Ecosystem respiration) of Indian forests is poorly understood. We analysed the CO<sub>2</sub> carbon exchange characteristics of a mature moist sal forest and a young mixed deciduous plantation located in the sub-tropical climate regime in the western Himalayan foothills of India using Eddy Covariance measurements. The study reveals that both the forests are absorbing significant amount of atmospheric CO<sub>2</sub> and the maximum intake of atmospheric CO<sub>2</sub> occurred during the post-monsoon season in both the forests. Later, analysis on how environmental parameters control the CO<sub>2</sub> exchange revealed that among the environmental factors, soil moisture showed maximum control on the carbon exchange of both the forest ecosystems. The carbon flux estimates and the environmental controls provided by this study would contribute significantly for calibration and validation of ecosystem models for estimation of the carbon budget of India in particular and the globe in general.



## 26. Advancing knowledge sharing and capacity building for restoring forests and landscapes

**Dr. Illias Animon**

*Forestry Officer, FAO, Bangkok*

**Brief About the Resource Person:** Dr. Illias Animon has over 35 years on acquaintance with forestry. He holds Ph.D. in forestry. He is a Regional Forestry Officer in FAO of the United Nations based in Bangkok. He led or supported the implementation of projects and programmes related to forest and landscape restoration in over 13 countries in Asia and the Pacific. He was a Forest Economist in FAO's Head Quarters in Italy for nearly a decade. Prior to that, he was an Associate Professor and taught and conducted research in forestry for more than a decade.



**Summary of the Presentation:** The momentum for forest and landscape restoration (FLR) is accelerating, as part of achieving the SDGs, Global Forest Goals, and the goals of the Bonn Challenge and the UN's Decade on Ecosystem Restoration. A regional strategy and action plan for FLR in Asia-Pacific, with six strategic priorities, is endorsed by FAO member countries. This includes (i) promoting learning, collaboration and coordinated action on FLR and (ii) supporting the use of various technical, social and institutional approaches for different landscapes and restoration objectives. The presentation will cover some efforts made in this regard, specifically for advancing knowledge sharing and capacity building.



## 27. Enhancing ecosystem services by building climate resilient watersheds

**Mrs. Neena Grewal**

*Project Director - Uttarakhand Decentralised Watershed Development Project-II,  
Uttarakhand, Dehradun*

**Brief About the Resource Person:** Mrs. Neena Grewal is an officer of Indian Forest Service of 1993 Batch from Uttarakhand and currently she is an Additional Principal Chief Conservator of Forests / Project Director, Uttarakhand Watershed Management Directorate. She has Masters of Philosophy Degree in Botany from University of Delhi and Post Graduate Diploma in Forestry from Indira Gandhi National Forest Academy, Dehradun. She has more than 28 years of professional experience in the management of forests and wildlife in various capacities such as Divisional Forest Officer in Andaman & Nicobar Islands, Goa, Uttar Pradesh & Uttarakhand, Conservator of Forests and Director, Rajaji Tiger Reserve



**Summary of the Presentation:** Uttarakhand being a hill state, is more vulnerable to severe soil erosion, flash floods, GLOFs and landslides due to its location, topography and underlying geology. Agriculture, the mainstay of the hills is mostly rain-fed and has remained traditional in its outlook as over 2/3 rd of the farm holdings are small and marginal (from 0.43 to 1.39 ha) and only 1/3 rd of the total arable land is irrigated.

World Bank funded the Uttarakhand Decentralized Watershed Development Project II (UDWDP II) also referred to as Gramya II was implemented in 82 micro watersheds by the Watershed Department. The project focused on building climate resilience by rejuvenating the natural resource base through significantly reducing soil erosion, runoff loss, and improving groundwater recharge. The project also constructed water harvesting structures and small irrigation systems on 40,000 ha arable land. It also focused on developing value chains for selected agriculture and horticulture commodities.

One of the primary strengths of the project was its decentralized planning process for developing Gram Panchayats Watershed Development Plan (GPWDP) undertaken with all the primary stakeholders. Innovations like the introduction of PME (Participatory Monitoring and Evaluation), and Women Aam Sabha, have proved to be successful in bringing holistic measures in the planning and development processes. The project introduced various initiatives on use of alternate energy, expansion of animal husbandry activities and agribusiness growth centers. Improved utilization of natural resources has been demonstrated through the increased area brought under cultivation (reducing the fallow area) as well as expanding the irrigated area. The project has demonstrated exemplary result in doubling farm income through strategic synergy between soil moisture improvement, demonstration of integrated crop management practices and cluster development approach.

## 28. Forest landscape restoration under ESIP – Success stories from the state of Madhya Pradesh

**Mr. S.P. Sharma**

*APCCF, Madhya Pradesh Forest Department, Bhopal*

**Brief About the Resource Person:** Shri S. P. Sharma is an officer of 1991 batch of Indian Forest Service. He has served in various capacities in Government of Madhya Pradesh, and Government of India. In his parent cadre, he has worked in all the spheres of Forestry in various capacities. His experience includes working as the Conservator of the Morena and Bhopal Forest Divisions, and as Additional Secretary, Forests, Government of Madhya Pradesh. He served the Government of India for a total period of 12 years. He has worked as Director to Government of India, in the Ministry of Agriculture, Department of Animal Husbandry, Dairying & Fisheries. He has also worked with the National Highways Authority of India for a total period of about 10 years. Shri Sharma won the P. Srinivas memorial prize during the course of his training in the Academy. The Government of M.P. awarded him the State Wildlife award in the year 2008 for effective management of the National Chambal Sanctuary. He has been a guest faculty to the Indian Academy for Highway Engineers, and a member of the Environment Committee of the Indian Road Congress; and has drafted various guidelines on environmental safeguards in highway projects. Presently, he is holding multiple charges at the State Headquarters as the Additional Principal Chief Conservator of Forests, including the charge of Nodal Officer, Green India Mission.



Summary of the Presentation: Green India Mission, being implemented in the state of Madhya Pradesh, is supported by the world bank aided Ecosystem Services Improvement Project (ESIP). The ESIP supports the goals of GIM by demonstrating models for adaptation-based mitigation through sustained land and ecosystem management and livelihood benefits as an additionality over GIM activities including attainment of better carbon sequestration potential. The presentation covers a holistic approach of forest landscape restoration. It includes good practices and success stories from the state of Madhya Pradesh about restoration of 3624 ha. of forest area through adaption (93.02% increase in Natural Regeneration) and planting of 11,75,963 plants, technology upgradation of 09 forest nurseries for production of quality planting material, development of a GIS based methodology of online monitoring of treated areas. the STARMAP (Spatial Technology Approach for Restoration Mapping and Planning). The project has Ensured sustainable livelihood benefits to 4391 households of local communities that depend on these resources; distribution of 3499 mahua flower collection nets to 925 households resulting into increased income to the families and significantly reducing the forest fire incidents. The ESIP project interventions in Madhya Pradesh fit into emerging global expectations of ecosystem services, carbon sequestration and emerge into a larger picture of Forest landscape restoration which may answer our prayers to combat climate change.



## 29. ESIP initiatives in restoration of degraded forests in Chhattisgarh

**Mr. Arun Kumar Pandey**

*APCCF, Chhattisgarh Forest and Climate Change Department, Raipur*

**Brief About the Resource Person:** Mr. Arun Kumar Pandey is an Indian Forest Service Officer of 1994 batch, and currently he is an Additional Principal Chief Conservator of Forests (Joint Forest Management & Policy Analysis), Chhattisgarh Forest and Climate Change Department. He is also serving the Chhattisgarh State Biodiversity Board as a Member Secretary. He is also serving Chhattisgarh State Centre for Climate Change as a Nodal Officer. He has more than 27 years of professional experience in the management of forests and wildlife in various capacities. He is implementing the Ecosystem Services Improvement Project in the state of Chhattisgarh.



**Summary of the Presentation:** The World Bank funded Ecosystem Services Improvement Project (ESIP) is being implemented in the state of Chhattisgarh with the objective to improve forest quality, land management and non-timber forest produce benefits for forest dependent communities. Chhattisgarh Forest and Climate Change Department is implementing the components on Strengthening capacity of government institutions in forestry and land management programs, and for improving forest quality in selected landscapes. Capacity and skills of the Forest Department, Forest Development Agencies, and local communities are being enhanced for improving management of forest and land resources and ensuring the delivery of sustainable benefits to local communities. Activities are being implemented pertaining to the quality improvement and productivity of the existing forests so as to ensure sustained flows of ecosystem services and carbon sequestration, and sustainable harvesting and value addition of non-timber forest products to provide forest and land resources and ensuring the delivery of sustainable benefits to local communities that depend on these resources, and improve ecological connectivity between critical biodiversity areas. Learnings of the ESIP by Chhattisgarh State Forest and Climate Change Department are highlighted in the presentation.

### 30. Learnings of Ecosystem Services Improvement Project on Measurement of forest carbon stocks and scaling up of SLEM practices

**Dr. R. S. Rawat**

*Scientist 'E' and Project Manager, ESIP, ICFRE, Dehradun*

**Brief About the Resource Person:** Dr. R.S. Rawat is currently working as Scientist 'E' in Biodiversity and Climate Change Division of Indian Council of Forestry Research and Education. He has professional experience of more than 24 years in the field of forestry especially on climate change. He was involved in developing State REDD+ Action Plans for the states of Mizoram, Uttarakhand, Himachal Pradesh and Sikkim. He was also involved in developing National REDD+ Strategy and Safeguards Information System for implementation of REDD+ activities in India. He was involved in preparation of NATCOM II, BUR I, II and III reports. He is actively involved in capacity building of the State Forest Departments in preparation of State REDD+ Action Plan and measurement of forest carbon stocks. He has published 64 research papers in the scientific journal of national and international repute, book chapters and 45 books. He is involved in implementing the World Bank funded Ecosystem Services Improvement Project as a Project Manager. He is recipient of ICFRE Outstanding Research Award 2019 for Excellence in Forestry, Brandis Prize for the year 2014 and Schlich Prize for the year 2007.



**Summary of the Presentation:** The World Bank funded Ecosystem Services Improvement Project (ESIP) is being implemented in the states of Madhya Pradesh and Chhattisgarh with the objective to improve forest quality, land management and non-timber forest produce benefits for forest dependent communities. ESIP aims to prevent land degradation and desertification and increasing above-ground forest carbon stock through a combination of investments. ICFRE is implementing a sub-component on forest carbon stocks: measuring, monitoring and capacity-building, and a component on scaling up of sustainable land and ecosystem management practices. Capacity buildings of State Forest Departments and Joint Forest Management Committees for measurement of forest carbon stocks are being done. Established two eddy covariance-based carbon flux towers for measuring the carbon fluxes of forests. Knowledge products on measurement of forest carbon stocks and SLEM best practices are also developed for capacity building of the stakeholders. SLEM best practices are being scaled up in private land holdings and common property resource lands. A roadmap for institutional and policy mainstreaming of sustainable land and ecosystem management in India has been developed with specific guidelines to different Ministries/ Departments/ Research Organizations/ Civil Society Originations to combat land degradation and desertification. SLEM Knowledge Sharing and Reporting System has also been developed for sharing of knowledge, learnings on SLEM and collection of data for preparation of report on India's progress towards combating desertification and land degradation.



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