FORESTS AND WATER

Traditional Forest Hydrology and Beyond

Editors

P.P. Bhojvaid

M.P. Singh

P. Kumar

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ACKNOWLEDGEMENT

Forest hydrology provides information for the much needed efforts to maintain and restore water related ecosystems. It focuses mainly on the physical interactions between forests and water that can address current and anticipated future scenarios including cumulative watershed effects, climate change and forest management practices. Asia Pacific Association of Forestry Research Institute (APAFRI), Malaysia and Forest Research Institute (FRI), Dehradun, India came together to jointly host an international workshop to address issues of forest hydrology in Asia Pacific region.

The platform offered through this workshop opens up opportunities to exchange concepts and experiences among eminent subject matter specialists and to share lessons learnt from case studies in Asia Pacific region on themes related to forest and water. I sincerely acknowledge the intellectual and technical inputs of all the people involved in bringing out this compendium of full papers of presentations to be made in the Asia Pacific Workshop on Forests Hydrology.

I take this opportunity to express my sincere thanks to Asia Pacific Association ofForestry Research Institutions (APAFRI) and Korea Forest Research Institute (KFRI) for sponsoring this Asia Pacific workshop on forest hydrology, the first of its kind in India. I extend sincere thanks to Technical Facilitation Organization (SLEM-CPP) - Directorate of Extension of Indian Council of Forestry Research and Education (ICFRE), Uttarakhand State Council for Science and Technology (UCOST) and Indian National Science Academy (INSA) for co-sponsoring the workshop. I am also grateful and thankful to Uttarakhand Forest Department and The International Centre for Integrated Mountain Development (ICIMOD) for coming forward to jointly organize a side event on “Water Forest and Climate Change in Hindu Kush Himalayas”.

FRI in association with various institutes of national importance like Central Soil and Water Conservation, Research & Training Institute (CSWCRTI), National Institute of Hydrology (NIH), Wadia Institute of Himalayan Geology (WIHG), Indian Institute of Remote Sensing (IIRS) and Indian Institute of Technology (IIT) - Roorkee as technical partners, was able to host a successful workshop. I express my gratitude and sincere thanks to all the technical partners for their contribution.

M.P. Singh

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CONTRIBUTORS

Antonio M. Daño
Ecosystems Research and Development Bureau
(ERDB-DENR)College, Laguna, Philippines

P.K. Gupta
Environment and Hydrology Division,
Space Applications Centre, Ahmedabad-380015, Gujarat

M.P. Singh
CC&FI Division
Forest Research Institute, Dehradun 248006,
Uttarakhand, India

S. Tarafdar
G.B. Pant Institute of Himalayan Environment &
Development, Garhwal Unit, Srinagar-Garhwal,
Uttarakhand, India

Tajinder Pal Singh
SLEM-TFO, Directorate of Extension, ICFRE,
Dehradun

S. Siti Aisah
Forest Research Institute Malaysia, Kepong 52109,
Selangor, Malaysia

Anindita Bhattacharyya
School of Water Resources Engineering, Jadavpur
University, Kolkata 700032

Siti Nurhidayu Abu Bakar
Faculty of Forestry, Universiti Putra Malaysia, 43400 UPM
Serdang, Selangor, Malaysia

Saibal Dasgupta
SLEM-TFO, Directorate of Extension,
Indian Council of Forestry Research and Education,
Dehradun 248006

H.B. Vasistha
Division of Forest Ecology & Environment
Forest Research Institute, Dehradun 248006

Jia LUO
Central South University of Forestry and Technology,
Changsha 410004, China

G.C.S. Negi
G.B. Pant Institute of Himalayan Environment and
Development, Kosi-Katarmal, Almora

Pankaj Kumar Roy
School of Water Resources Engineering, Jadavpur
University, Kolkata 700032, India

Basanta Raj Guatam
Arbonaut Ltd., Kaislakatu 2, 80130 Joensuu,
Finland

Dao Nguyen Khoi
Faculty of Environmental Science,
University of Science, Vietnam National University,
Ho Chi Minh City, Vietnam

Qiuzhi-Jun
Research Institute of Tropical Forestry,
Chinese Academy of Forestry, Guangzhou,
Guangdong Province 510520, China

Srishti Singh
Forest Research Institute,
P.O. I.P.E., Kaulagarh Road, Dehradun, India

G. Singh
Division of Forest Ecology, Arid Forest Research Institute,
New Pali Road, Jodhpur 342005, India

B.M. Dimri
FS&LR, Division, Forest Research Institute,
P.O. New Forest, Dehradun 248006, Uttarakhand

Sudipto Bhowmik
Forest Research Institute (Deemed) University
Dehradun

M. Al-Amin
Institute of Forestry and Environmental Sciences,
University of Chittagong, 4331, Bangladesh

Neetu Bharti
Department of Environment and Water Management,
A.N. College, Patna, Bihar, India

Sunita Singh
Dhule Circle, Dhule, Maharashtra 424001,
India

N. Kavitha
Center of Excellence for Change Management,
III floor Chief Architect Building, PWD Complex,
Chepauk, Chennai 600005

Jagdish Chander
Govt. of Haryana, Forest Department, Pinjore,
District Panchkula, Haryana State, India

Soumya Kanti Ghosh
Forest Research Institute (Deemed) University,
Dehradun 248195, Uttarakhand, India

Mukesh Prasad
Forest Ecology and Environment Division,
Forest Research Institute, Dehradun 248006,
Uttarakhand, India

R.S. Negi
Deptt. of Rural Technology,
HNB Garhwal Central University,
Srinagar Garhwal, Uttarakhand, India

A.K. Mishra
Department of Forests & Environment,
Govt. of Jharkhand Van Bhawan, Doranda,
Ranchi 834002, Jharkhand, India

Dipika Rana
Himalayan Forest Research Institute,
Conifer Campus, Panthaghati,
Shimla 171009, Himachal Pradesh

INTRODUCTION

Clean water is fundamental human need. Globally, one in six people still do not have access to clean water even today. Although the target of halving, by 2015, the proportion of people who are unable to reach or afford safe drinking water, was adopted at the United Nations Millennium Summit in 2000 (FAO, 2013). There will still be by the year 2025, 1.8 billion people living in regions with absolute water scarcity.

Forests influence the quantity and quality of available water and regulate surface and groundwater flows. The most significant contribution of forests in the hydrological cycle is in maintaining high-quality water through reduction of soil erosion and sedimentation and bio-filtering other water pollutants. Riparian forests along stream channels and drinking water supply forested watersheds present the best examples of maintaining water quality.

The dense and deep root system of forest soils and the high porosity of the surface litter make for excellent water infiltration and retention capacity. Natural sponge function of forests reduces surface runoff during the wet seasons and recharges ground water more efficiently. As a result, they provide hydrological regulatory functions for stream flow during the year. Many of the forests, therefore, constitute head water catchments for large rivers and play a major role in regulating the hydrological services in the river basins and beyond. These forested catchments also account for a high proportion of water supplied for domestic, agricultural, industrial and ecological needs in both upstream and downstream areas. However, it must be acknowledged that a greater quantity of water is given back to the atmosphere through evapo-transpiration affecting the water yield especially in arid or semi arid conditions.

Forests and water form the basis of foundation for terrestrial life through ecological functions. Forest management is thus a tool for maintaining and developing the dynamic relations between forests and man. It is guided by his changing needs and scientific understanding of the forests ecosystems. Consequently there has been a paradigm shift in forest management also over the years from timber centric management to multiple functions' forestry. It is recognised that the forests are also sources of water (surface, sub-surface and ground water). Over-exploitation of the ground water resources results in declining ground water levels; necessitating augmentation of the ground water resources through suitable management interventions. Further forest management practices are being dovetailed with the principles of watershed based development approach especially in the source areas of water. Such areas have restrictions on tree felling along with suitable prescriptions to improve the water regimes and natural regeneration. Heavy rains and rapid run-off severely affect not only the top fertile soil but leads to formation of gullies within forest areas. Suitable management imperatives are formulated and implemented to stop forest degradation due to natural causes and calamities. Apart from silvicultural operations, appropriate prescriptions are also made for conservation of soil and water in the forest areas. Areas susceptible to soil erosion such as steep slopes and areas in the vicinity of perennial streams are the focus of soil

and water conservation interventions. There is greater emphasis on maintenance and enhancement of riparian forests along streams for their hydrological regulatory functions for improved quality and quantity of water availability for mankind.

Forest hydrology deals with this interaction between forests and the water cycle providing useful information for the much needed efforts to maintain and enhance hydrological regulatory functions of forests. Traditional forest hydrology has over the years focused on direct effects of forest management on hydrological processes from plot study, process study and watershed experiments. Today, the challenge before us is to apply these principles to predict how hydrologic processes respond to the many forms of change, including climate change, in forest landscapes. As a consequence, research in forest hydrology has shifted towards the study of reforestation hydrology, large-scale watershed hydrology, climate change impacts, and application of hydrological models using modern tools and techniques. This allows for analysis of forest and water connections over large areas to make predictions about forests and water that can address current and anticipated future issues, including cumulative watershed effects, climate change, and forest management practices.

The present book is a synthesis of various forest hydrological studies, review papers, application of modern tools and techniques in forest hydrology and case studies on management interventions for better augmentation of water sources from Asia Pacific region. The book has five thematic sections. Theme I, Forest Hydrology, covers papers on hydrological studies establishing interactions between forest biophysical conditions and hydrological parameters from Philippines, China, India, Nepal. Theme II, Forest Hydrology and Climate Change, examines the potential climate change impacts on forest hydrology, impacts of removal of forests on hydrology and the response of hydrological characteristics to climate change. Theme III, Forestry and Soil & Water Conservation looks at the role of forests in the context of soil and water conservation, in reducing water, soil and nutrient losses and their impacts on livelihood security and prevention of degradation. Theme IV, Water Quality, examines the role of water management practices in forested catchments on the quality and quality of surface waters. Theme V is a collection of case studies addressing impacts of degradation, deforestation and climate change on water resources and the role of communities in management of water resources.

M.P. Singh

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