

RIVERINE SYSTEMS

Hydrological, Hydrosocial and Hydro-heritage Dynamics

By Tirumalesh Keesari*

Being an ardent researcher in the field of environmental science, applied geology and geochemistry, Prof. Abhijit Mukherjee has edited this very important, useful and timely publication on ‘Riverine Systems’ providing a unique opportunity to integrate the knowledge on regional-scale riverine reviews to local-scale case-studies, ranging from availability to pollution, national-level river management to transboundary governance. Prof. Mukherjee has to his credit two books, “Groundwater of South Asia” (Springer) and “Global Groundwater: Source, Scarcity, Security, Sustainability, Solutions” (Elsevier) as lead editor those were well appreciated by both domestic and foreign scientific fraternity. With the kind of riverine network India is endowed with (14 major rivers each of which having catchment area of ~ 20000 km² and above) and the instrumental role it played in nurturing the civilization of the Indian sub-continent, this publication on specifics of riverine systems is an eagerly awaited one and has the potential to boost the scientific spirits for enhanced research in riverine systems.

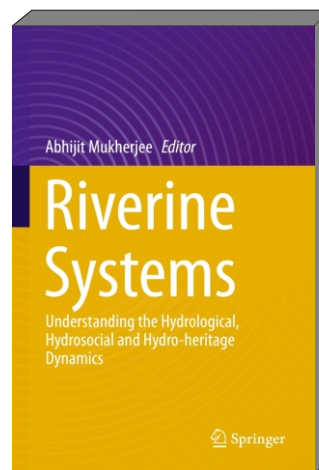
With a vast experience in articulation of the scientific issues and also being one of the top 50 leading scientists of India under the age of 50 years, Prof. Mukherjee has performed this herculean task of detailing the connect between the science of rivers and its history and socio-politics and well-articulated the due credence of rivers from ancient civilizations to modern human societies. A total of 23 chapters are presented in this book by leading experts and researchers from across the globe focusing hydrology, hydrosocial and hydro-heritage aspects, thus providing a much-needed knowledge on the river studies for historians, scientists, planners, social scientists and policymakers.

A major share of the book deals with hydrology of rivers, looking at their geography, fluvial processes, environmental attributes and planning through sustainable management of freshwater environments by planners, agriculturalists, industrialists, conservationists and engineers. Under this section, vulnerability and resilience status, flood hazard, effect of changing climate, natural and anthropogenic impacts are covered through case studies from various basins across India. An important aspect of environmental flow was detailed by Jain et al. in the first chapter covering very important river systems of Indo-Gangetic Plains. Further, authors provide practical and simple guidelines for future environmental flow assessments. Rajesh et al (chapter 12) describes the environmental flow impacts on water quality and utility of flow duration curve and runoff index for assessing low flow events. The status of pollution and rejuvenation of river Ganga has been a hot topic since a long time in India, authors Simon and Joshi (chapter 2) provide a very critical information on this aspect and from the lessons learnt through few global river rejuvenation attempts, the authors very carefully recommend the interventions needed for strengthening the rejuvenation program for river Ganga. Not much information is available for North-eastern parts of India with regard to vulnerability and resilience of river systems. Thakur et al (chapter 5) chose Brahmaputra river to highlight the water demand, impact of urban bodies, emerging contaminants and climate change on river system. The authors construe that existing approaches and improvement programmes by the policy makers have not yet perceived the change in climate as a critical factor and the impact it can have on the hydrogeological features and socio-economic dynamics of entire north-eastern India.

The climate change impacts are discussed for Western Himalayas by Lone et al (chapter 8) who used environmental isotopes to confirm that snow melt contributes up to 58% of river discharges. Another very interesting river pollution study was articulated by Ramya Priya and Elango (chapter 9) on Cauvery River Basin that flows across four southern states of India. The nature of aquifers and their relationship with Narmada-Sone Lineament in Narmada River Basin was dealt by Sudarshan Sahu (chapter 10).

The four chapters on hydrosocial exposition help to reorient human approach of studying rivers as an object, to understand water as being integrally embedded in its social

Riverine Systems
 – Understanding the Hydrological,
 Hydrosocial and
 Hydro-heritage Dynamics
 Editor: Abhijit Mukherjee
 Springer International Publishing,
 January 2022



Dr. Tirumalesh Keesari is a Scientific Officer-G in Isotope Hydrology Section of Isotope Radiation and Application Division (BARC) and also Associate Professor in Chemical Sciences (HBNI). His research interests include water contamination, geochemical modeling, groundwater recharge, spring revival in Himalayan regions, coastal salinity and studies on extreme climatic regions of India through application of isotope technologies. He has over 90 international journal publications to his credit and also a recipient of IANCAS Tarun Datta Memorial Award, DAE Science and Technology Award and Indo-US Science and Technology Award.

context to adjust to human agencies, power asymmetries, and fostering socially-just solutions. In my view, water-human nexus study in large riverine islands of India, Bangladesh and Vietnam by Kumar et al. (chapter 14) is very informative. This chapter provides alternatives that explicitly account for plausible and co-evolving trajectories of socio-hydrological system, which further yield both insights into cause-effect relationships and help stakeholders to identify safe functioning space. The gravity of concern about interlinking rivers (ILR) in India is huge and quite evidently has been associated with acrimonious debates. Ghosh and Modak (chapter 15) articulated this aspect through tenets of the new emerging paradigm and argue that given the constraints, it does not seem that a project of this mammoth proportion will really be sustainable. The authors go on to highlight the previous instances from USA and UK in support of their interpretation/argument. Jayant Basu (chapter 16) details the issues in transboundary river water sharing pertaining to Teesta river and suggests, Nature Based Negotiated Approach (NBNA) for addressing transboundary conflicts including those in South Asia.

And finally, the seven chapters on hydroheritage explore the link between the river flows and the cultural landscape of a region. Joy Sen (chapter 17) presents a deep exploration of three principal rivers (Ganga, Yamuna and Sarasvati), which collectively reinforces the deep ecosystem sustaining the northern Indian Plains. A detailed account of water practices in India since ancient ages has been provided by Jain et al (chapter 18). Authors state that extensive use of technology at all scales would become essential to address the increasing water stresses in India. The impact of geodynamics and tectonics on shaping the river migration and water resource availability in many parts of thickly populated Indo-Gangetic alluvial plain has been discussed Kaushik et al (chapter 19) with a special reference to Vedic River Saraswati. Similar studies were presented for riverine systems in Odisha region by Jana et al (chapter 21) and Bengal region by Kalyan Rudra (chapter 22).

Our research group (Isotope and Radiation Application Division, BARC) presented the impact of river flow on groundwater recharge (chapter 20). Here we explained the dynamics of the groundwater recharge and interconnectivity between various zones using environmental stable and radioisotopes. We propose that the major control on the groundwater dynamics is hydrogeological anisotropy of the subsurface and also highlight that deep groundwater sustainability is questionable due to presence of paleo-waters in this region. This chapter also highlights the need for augmenting the shallow aquifer recharge through rainwater conservation, failing which might adversely impact the future water security in this region. In my view, this book is the first step towards integration of ideas, history and knowledge of this invaluable resource for this immensely populous and diplomatically important area of the world, such that we would be able to effectively understand, manage and preserve the rivers for our future generations.

**Author for Correspondence: Dr. Tirumalesh Keesari
E-mail: tirumal@barc.gov.in*

in short about the book

- **A unique knowledge on** the river studies for historians, scientists, planners, social scientists and policymakers, and are written by leading experts and researchers from across the globe
- **Provides a practical understanding of** the inherent issues of river ecology, their conservations, chronicles and governance through multi-faceted state-of-art knowledge of hydrology, hydrosocial and hydro-heritage approaches