

10<sup>th</sup> International Groundwater Conference (IGWC 2025)  
**Groundwater Vision 2047**  
**Towards Water Security under Changing Climate**  
March 05-07, 2025, NIH Roorkee, India



*Editors*

Santosh Murlidhar Pingale  
Nitesh Patidar  
Sumant Kumar  
Gopal Krishan  
Suhas D. Khobragade  
Anupma Sharma  
M.S. Rao

*Organized by*



National Institute of Hydrology, Roorkee, India

*in association with*



Central Ground Water Board,  
India



Association of Global  
Groundwater Scientists



National Mission for Clean  
Ganga, India



National River  
Conservation  
Directorate, India



British Geological  
Survey,  
United Kingdom

British  
Geological  
Survey



Hochschule für  
Technik und  
Wirtschaft Dresden,  
Germany



KTH Royal Institute  
of Technology,  
Stockholm, Sweden

National Institute of Hydrology Roorkee  
Jal Vigyan Bhawan,  
Roorkee-247667 (Uttarakhand), India

©2025, National Institute of Hydrology Roorkee

Groundwater Vision 2047  
Towards Water Security under Changing Climate

Santosh Murlidhar Pingale, Nitesh Patidar, Sumant Kumar, Gopal Krishan, Suhas D.  
Khobragade, Anupma Sharma and M.S. Rao (*Editors*)

ISBN: 978-81-985577-8-0

All rights reserved

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the publisher.

Typeset by Paramount Offset Printers, Roorkee  
Printed in India

## Contents

Title	Page No.
<i>Preface</i>	<i>i</i>
<i>About the IGWC Series</i>	<i>iii</i>
<b>IGWC 2025 Keynotes</b>	1
<b>Theme 1:</b> Impact of Climate Change on Groundwater & Adaptation Measures	73
<b>Theme 2:</b> Environmental Flow and Rejuvenation of River Ganga	113
<b>Theme 3:</b> Mountain Hydrology & Springshed Management	131
<b>Theme 4:</b> Water Resources in Arid & Semi-Arid Regions	187
<b>Theme 5:</b> Groundwater Contamination and Remediation	233
<b>Theme 6:</b> Groundwater Modeling and Management	355
<b>Theme 7:</b> Advanced Techniques for GW Exploration & Assessment	403
<b>Theme 8:</b> Augmentation of Groundwater Resources	453
<b>Theme 9:</b> Coastal Water Resources Management	495
<b>Theme 10:</b> Policy, Regulation, Governance and Community Participation for Groundwater Management	513
<b>Theme 11:</b> Application of AI, ML, IoT, Cloud Computing & Other Advanced Techniques	525
<b>Theme 12:</b> Vadose Zone Hydrology and Agriculture Water Management	577
<b>Theme 13:</b> Protection of Groundwater Dependent Ecosystems	607
<b>Theme 14:</b> Isotopic Techniques in Groundwater Investigations & Management	643
<b>Acknowledgement</b>	675