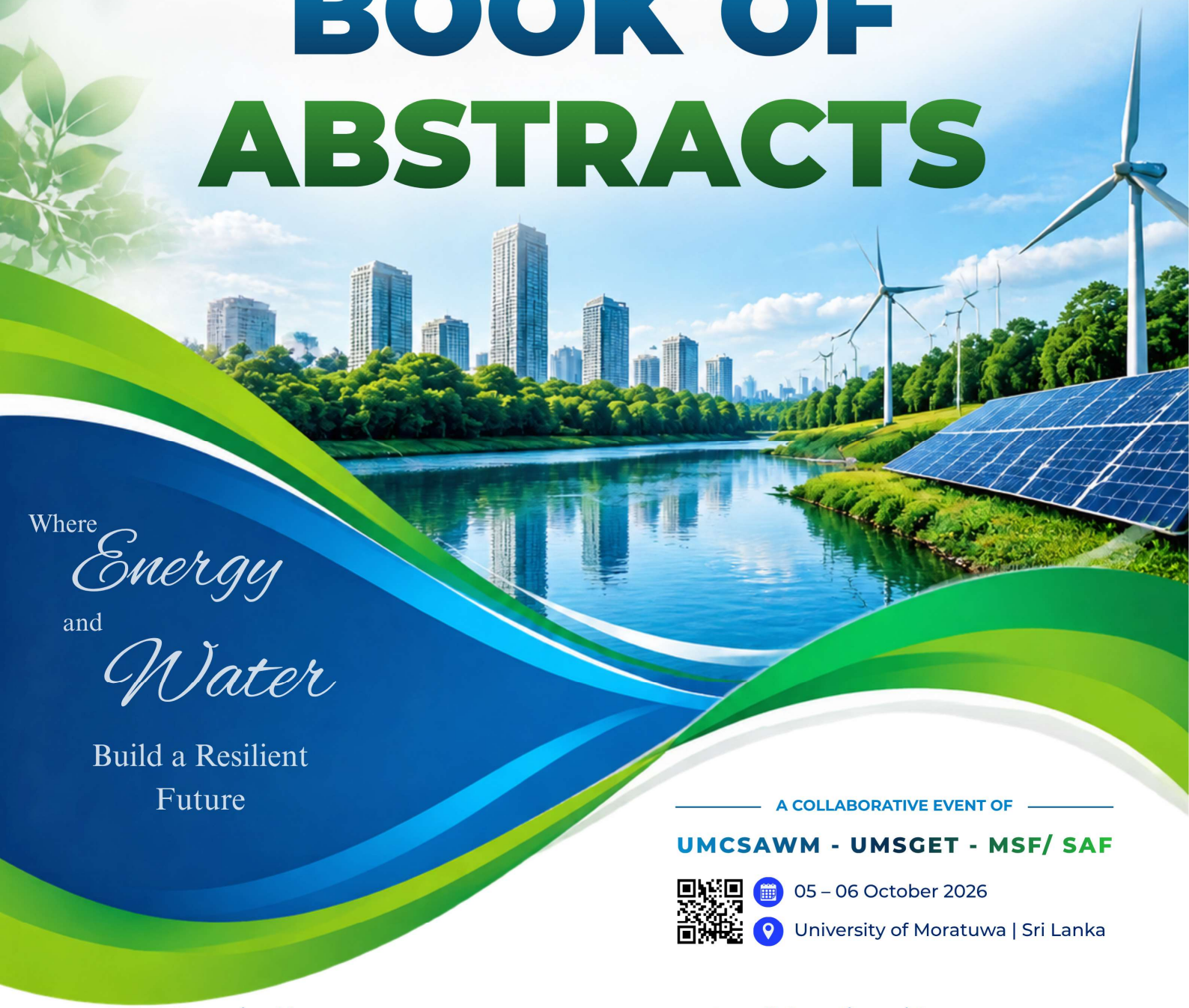
ISSN 3121-5602

ICEWSE 2026

2ND INTERNATIONAL CONFERENCE ON ENERGY AND WATER FOR SUSTAINABLE ENVIRONMENT

ADVANCING THE ENERGY-WATER NEXUS FOR A SUSTAINABLE AND RESILIENT FUTURE

BOOK OF ABSTRACTS



Where *Energy* and *Water* Build a Resilient Future

A COLLABORATIVE EVENT OF

UMCSAWM - UMSGET - MSF/ SAF

05 – 06 October 2026

University of Moratuwa | Sri Lanka

Organized by

In collaboration with

ICEWSE 2026

2ND INTERNATIONAL CONFERENCE ON ENERGY AND WATER FOR SUSTAINABLE ENVIRONMENT

ADVANCING THE ENERGY–WATER NEXUS
FOR A SUSTAINABLE AND RESILIENT FUTURE

BOOK OF ABSTRACTS

05 – 06 October 2026
Main Auditorium, Department of Civil Engineering
University of Moratuwa, Sri Lanka

EDITED BY

Prof. R. L. H. Lalith Rajapakse, UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Sri Lanka

Prof. R. Arun Prasath, UNESCO Madanjeet School of Green Energy Technologies (UMSGET), Pondicherry University, India

A collaborative event of UMCSAWM – UMSGET – MSF/SAF

Published By

UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM),
University of Moratuwa, Sri Lanka
Tel: +94 011 77 47 550
icewse.publications@gmail.com
umcsawm@uom.ac.lk

Disclaimer

The views, opinions, findings, and conclusions expressed in the abstracts, studies, and other contributions included in this publication are solely those of the respective authors, and their inclusion in this publication does not imply endorsement by ICEWSE 2026 or the UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM) of the opinions so expressed.

Official website of the conference

https://umcsawm.uom.lk/icewse-2026/

Book of Abstracts of the 2nd International Conference on Energy and Water for Sustainable Environment 2026 (ICEWSE 2026)

Edited by,

Prof. R. L. H. Lalith Rajapakse, UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Sri Lanka

Prof. R. Arun Prasath, UNESCO Madanjeet School of Green Energy Technologies (UMSGET), Pondicherry University, India

ISSN 3121-5599 (Print)
ISSN 3121-5602 (Online)
DOI: https://doi.org/10.31705/ICEWSE.2026

Copyright © 2026 UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM) All rights are reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without prior written permission of the publisher.

BOOK OF ABSTRACTS
ISSN 3121-5602

Contents

About ICEWSE 2026 ..... **xii**
Message from the Vice-Chancellor, University of Moratuwa ..... **xiii**
Message from the Dean, Faculty of Engineering ..... **xiv**
Message from the Head, Department of Civil Engineering ..... **xv**
Message from the Principal Trustee, Madanjeet Singh Foundation ..... **xvi**
Message from UNESCO ..... **xvii**
Message from the Conference Co-Chair and Convenor (Water) ..... **xviii**
Message from the Conference Co-Chair and Convenor (Energy) ..... **xix**
University of Moratuwa, Sri Lanka ..... **xx**
UMCSAWM and the Department of Civil Engineering ..... **xxi**
UNESCO Chair on Sustainable Water Resources Management in South Asia ..... **xxii**
Professor R. L. H. Lalith Rajapakse ..... **xxiii**
Professor R. Arun Prasath ..... **xxiv**
Pondicherry University, UMSGET and the UNESCO Chair on RCESD ..... **xxv**
South Asia Foundation (SAF) and Madanjeet Singh Foundation (MSF) ..... **xxvi**
Organising Committee ..... **xxvii**
Programme Advisory Committee ..... **xxviii**
Organising Committee Members ..... **xxx**
Programme at a Glance ..... **xxxi**
Opening Ceremony ..... **xxxiii**
Technical Sessions and Session Chairs ..... **xxxiv**
Keynote Addresses **1**
Water, Climate and Future of Resilience: Rethinking Sustainable Development in South Asia 2
M. G. Maswabi
Materials for Renewable Energy Harvesting and Storage: Fostering Renewable Energy at HEIs for a Sustainable Environment 3
R. Arun Prasath
Energy Transitions for Environmental Resilience: Integrating Smart Grids for a Net-Zero Future 4
W. D. A. S. Rodrigo
Integrated Multi-Proxy Techniques for Assessing Submarine Groundwater Discharge and Saline Intrusion along the Coastal Tracts of South-Eastern India: Implications for Sustainable Water Resources 5
K. Srinivasamoorthy, G. Ponnumani, A. Rajesh Khanna, K. Ramesh, V. Gopalakrishnan and D. Supriya Varshini
Invited Lectures **6**
The SOHAN Nexus: An Equipartition Ruler for Coupled Socio-Technical Systems 7

R. M. M. Pradeep
Towards Sustainability and Circular Economy in Biofuel Production 8
B. M. Jaffar Ali
Molecular Engineering of Carbon-Based and Organic Functional Materials for Sustainable Energy Applications 9
D. S. Sharada
Cyclone Ditwah as a System Stress Test: Lessons for Flood Risk Management in Sri Lanka 10
C. Perera
Bhote Koshi–Rasuwa Disaster in August 2026: Relevance and Takeaways for Countries from the Himalayas to the Sea 11
P. R. Pandey
When Water Becomes a Disaster: Nepal's Floods, Climate Injustice, and the Energy–Water Nexus 12
U. Pahadi
Sand Mining and Bridge Pier Scour in the Kelani River of Sri Lanka: A 2D Modelling Study 13
A. W. Thembiliyagoda, P. K. C. De Silva and T. M. N. Wijayaratna
Valorisation of Mass-Cultured Marine Macroalgae *Chaetomorpha sp.* for Biodiesel Production and Value-Added Products 14
L. M. Tom, K. Mohammed Aslam, P. Gowdham Suriya and S. Sivasankari
Transition to the World of Microalgae for the Water–Biomolecule–Biofuel Nexus: Illuminating the Path to Foster a Greener Ecosystem and the SDGs 15
K. K. Jaiswal
GIS and Multi-Criteria Decision Analysis for Sustainable Development of Coastal Water Bodies Created by 2004 Tsunami and Tectonic Subsidence in Andaman and Nicobar Islands, India 16
E. Yuvaraj, R. Kirubashankar, S. Rassel, S. Gokul, A. R. Adharsh and A. Saravanan
Special Lecture 17
Planet Green Force: From Green Education to a Living Laboratory for Water, Energy and Climate Action 17
H. Wickrema
Oral Presentations: Water Track 18
Separating Recharge Receptivity from Flood-Water Availability for Managed Aquifer Recharge in Wadi Qanunah, Saudi Arabia: A Physically Informed Framework Corroborated by an Operational Well Network 19
I. M. Gaber, A. Alghazi and A. M. E. Kenawy
Sea Level Rise and Household Vulnerability: Evidence from Coastal Bangladesh 20
R. Biswas
Climate Change–Hydropower Reliability Framework: Linking Climate, River Flow and Energy Security in the Punatsangchu and Wangchu River Basins, Bhutan 21
C. Zam
Spatio-Temporal Dynamics in Climatic Moisture Balance across Sub-Saharan Africa under the High-Emission SSP5-8.5 Scenario 22
G. Fernando and M. Leh
The Water-Energy Nexus as a Determinant of Resilience for Future Generations: A Comparative Legal Analysis of Southern Africa and South Asia 23
P. P. Maweto

Implementation of a Pilot Climate Information Sharing and Early Warning Dissemination System in Matara District, Sri Lanka 24

S. Dissanayaka, N. Eriyagama, L. Muthuwatte, D. Sithara, H. Jayasekara and N. Alahakoon

Identification of Emerging Extreme Rainfall and Drought Events in Sri Lanka Using High-Resolution Downscaled Climate Projections and Precipitation Indices (1985–2100) 25

D. S. E. Gamage, H. Jayasekara, N. Eriyagama, S. Dissanayake, L. Muthuwatta and K. Bergaoui

Water Security, Citizenship and Urban Ecology of Bangalore 26

T. D. Jessly and H. Basarat

Post-Flood Plankton Assemblage Structure as a Bio Indicator Tool for Reservoir Health Assessment: A Case Study from Mahawilachchiya Tank, Dry Zone, Sri Lanka after Ditwah 27

S. K. K. A. Perera, S. A. M. A. I. K. Senanayake

Projected Changes in Global Holdridge Life Zones under Climate Change 28

M. W. W. P. Senarathna, G. M. C. A. Perera, T. A. J. G. Sirisena and R. L. H. L. Rajapakse

When Safe Relocation Becomes Long-Term Vulnerability: A 20-Year Assessment of Post-Tsunami Housing Resilience in Seruthur, Nagapattinam, Tamil Nadu 29

A. Aravinth, P. Sudhakaran and D. Jayakrishnan

Identification of Water Security Solutions through Knowledge Exchange and Citizen Science 30

S. P. Renganayaki, D. Sridhar and M. Thabrez

Spatial Dipole in Bangladesh Meteorological Drought Trends (1971–2024) and Precipitation-Source Sensitivity of Reanalysis-Based SPEI 31

S. R. S. Chowdhury, N. Ibnat, M. J. Bhuiyan and F. Kabir

Subsurface Marine Heatwaves and Ocean Productivity Disruption in the Bay of Bengal, 2002–2020 32

A. Devan, A. R. Adharsh, S. Gokul, and E. Yuvaraj

Integrated Hydrogeochemical and Modelling Approaches for Seawater Intrusion Studies in Coastal Aquifers of Pondicherry and Tamil Nadu, India 33

K. Ramesh, D. S. Varshini, K. Srinivasamoorthy, A. R. Kanna, V. Gopalakrishnan

Remote Sensing and GIS-Based Environmental Sensitivity Index Mapping for Coastal Vulnerability Assessment along the Western Shoreline, Sri Lanka 34

J. De Silva, H. Wijethunge and R. Galappaththi

Spatial and Temporal Variability of Ocean Acidification Indicators in Negombo Lagoon and Adjacent Coastal Waters, Sri Lanka 35

P. Ashanka, R. S. Diyabalanage, R. R. M. K. P. Ranatunga

Machine Learning for Flash Flood Prediction in Ungauged Basins: A Review of Global Applications and Their Relevance to Sri Lanka 36

M. M. J. R. Malwattegedara, L. N. Gunawardhana and R. L. H. L. Rajapakse

Assessment and Characterization of Groundwater Resources for the Sustainable Water Supply of Animals at the Mawana Game Reserve (MGR, KwaZulu-Natal, South Africa) 37

W. S. D. Djomatchoua

An Event-Adaptive Coupling Architecture for Simulating Non-Stationary Baseflow–Recharge Partitioning in Groundwater–Surface Water Systems under Hydroclimatic Whiplash 38

N. K. Meshram

From Anthropogenic Hazard to Groundwater Risk: Hydrostratigraphic and Recharge Controls in a Multi-Aquifer Coastal System 39

D. S. Varshini, K. Ramesh, K. Srinivasamoorthy

Seasonal Evaluation of Groundwater Quality and Health Risks Associated with Chromium in the Ranipet Industrial Region of Tamil Nadu, India, Employing the Water Quality Index and Age-Specific Risk Assessment 40

V. R. Lakshmanan, L. Krishnamoorthy

Assessment of Trace Metal Distribution and Drinking Water Suitability of Dug Wells across Urban, Suburban and Rural Areas in Batticaloa District, Sri Lanka 41

T. A. Farween and A. J. M. Harris

Assessment of Crop Water Requirement of *Capsicum chinense* Grown in a Protected House: A Stable Water Isotope Based Method 42

S. A. S. Tharundya, R. R. U. R. Perera, E. A. N. V. Edirisinghe, N. S. Withanage, G. Abhiram, S. Priyadarshanee, M. Kalpage and H. P. K. Liyanage

A Remote Sensing-Based Geospatial Framework for Assessing Crop Water Dynamics 43

B. H. I. A. Jayathissa and M. Leh

Seasonal Irrigation Return Flow Coefficients in Dry-Zone Sri Lanka: An Integrated Water Balance and Hydrological Modelling Framework 44

S. P. J. Thisurika, P. K. C. De Silva, H. G. L. N. Gunawardhana and R. L. H. L. Rajapakse

Optimizing the Maha-Cultivation Calendar to Enhance Water-Use Efficiency and Support Third-Season Cropping in the Akkarayan Irrigation Scheme, Sri Lanka 45

K. M. Aafir, H. A. T. N. Perera, N. Saheedha, S. Narmathan and A. L. Manasar

Pollution Load and Assimilative Capacity of an Urban Tropical Lake: A Case Study of Boralesgamuwa Lake, Sri Lanka 46

H. U. Isuranga, J. K. S. Rashmika, D. D. Dissanayake, K. A. Perera, N. Wickramasena and S. A. M. A. I. K. Senanayake

Copula-Based Agricultural Drought Risk Zonation in Sri Lanka Using Era5 Re-Analysis Data for Climate-Resilient Farming 47

T. M. N. Peiris, H. M. R. C. Herath, R. M. P. Fernando, A. R. Warnasuriya, S. Viswakula and D. Halwatura

Comparative Evaluation of *Bunchosia armeniaca* Plant-Derived Silver Nanoparticles for Catalytic and Photocatalytic Environmental Remediation 48

A. D. Dilan, B. Gunaratne, O. Perera and M. Kandiah

Translating Blue-Green Infrastructure Principles into Urban Practice: Development of a Scoring-Based Implementation Toolkit 49

R.M. Kollarath and J. Chadchan

Biosorbents for Simultaneous Removal of Fluoride and Hardness in Drinking Water: Comparative Evaluation of *Musa spp.* (Embul and Seeni) Pseudostem Fibers 50

D. D. Dissanayake, J. K. S. Rashmika, J. D. Silva, K. A. Perera, A. Cooray, and S. A. M. A. I. K. Senanayake

Assessing Treated Municipal Wastewater for Irrigation Suitability and Nutrient Reuse Potential Using Biochar- and Ceramic-Based Constructed Wetlands in Dhaka, Bangladesh 51

S. T. Zaman, S. Akther, Hassan Md. R, Mikko Kuusisto

Evaluating Nature-Based Solutions for Flood Mitigation under Single and Consecutive Extreme Storm Events in the Attanagalu Oya Basin, Sri Lanka 52

H. D. O. N. Sandamini, T. M. N. Wijayaratna, L. N. Gunawardhana and R. L. H. L. Rajapakse

Sewage Sludge Biochar as a Functional Catalyst for Microbial Nitrogen and Sulphate Removal in Vertical Flow Constructed Wetlands 53

A. Pawaiya and S. Suthar

Assessment of Bacterial and Biochar Functionalization of Alginate-Coated Zinc Anodes for Bioelectrochemical Energy Generation in Wastewater 54

R. Nithya, V. Pavithra, P. G. Suriy and S. Sivasankari

Green Synthesis of Copper Oxide Nanoparticles Using *Cyanthillium cinereum* as a Sustainable Photocatalyst for Wastewater Treatment 55

M. M. C. H. Jayawardene, M. Kandiah, O. Perera, B. Gunaratne, D. Perera

Eco-Friendly Synthesis of Copper Oxide Nanoparticles from *Oryza sativa* Rice Husk Extracts for Water Pollutant Treatment 56

S. K. Nadeem, M. Kandiah, O. Perera, B. Gunaratne and D. Perera

In vitro Green Synthesis of *Artocarpus altilis* Copper Oxide Nanoparticles: A Nano-Catalytic Approach in Wastewater Treatment 57

M. I. Ismail, M. Kandiah, O. Perera, B. Gunaratne and D. Perera

Delineation of Groundwater Potential Zones along the Kelavarapalli–Krishnagiri Reach, Tamil Nadu, Using an Integrated Multi-Influencing Factor, AHP, and Bivariate Statistical Framework 58

P. P. Sreenivasan, S. T. D. Ur Rahman, R. Gokul, S. Yuvraj and V. Narayanamurthi

Land Cover Controls on Thermal-Hydrological Stress: A Differential Evolution-Weighted Ecosystem Index Approach 59

J. B. A. Srimali, H. G. L. N. Gunawardhana, T. M. N. Wijayaratna and R. L. H. L. Rajapakse

Geospatial Assessment of Urban Flash Flood Risk and Vulnerability in Kolonnawa, Sri Lanka 60

W. R. S. Alwis and M. S. M. Razik

Evaluating SMAP L4 Root-Zone Soil Moisture against Hydrologically Simulated Soil-Water States in the Upper Kelani River Basin, Sri Lanka 61

Y. A. D. K. H. Wijayarathna, H. G. L. N. Gunawardhana, G. M. C. A. Perera

Satellite-Driven Aboveground Biomass Mapping and Its Hydrological Implications in Sri Lankan Tropical Catchments 62

K. H. T. Chamika, B. C. Dissanayake, Chamal Perera and R. L. H. L. Rajapakse

Spatial Quantification, Prioritization, and Comparing Soil Erosion risk across Agro-Ecological Zones in Werie Watershed, Northern Ethiopia: A RUSLE Model, GIS and Remote Sensing Approach 63

G. E. Haile

Field-Deployable Smartphone Optical Metrology for Climate-Resilient Water Quality Surveillance 64

M. B. Chu

A Remote Sensing and Machine Learning Framework for Ungauged Reservoir Operation under Climate Change 65

S. V. Subasinghe, G. M. C. A. Perera, R. M. J. Bamunawala and R. L. H. L. Rajapakse

Satellite-Based Assessment of Ditwah Cyclone Flood Impact and River Proximity Patterns Using Sentinel-1 and Rainfall Data 66

W. M. I. V. Wickramasinghe and G. R. L. Kodikara

Assessing Flood Attenuation Services and Hydrological Resilience of Wetland Environments in the Kelani River Basin, Sri Lanka 67

L. O. H. Perera and E. J. Warusavitharana

Development of a Harmonized Long-Term Global River Discharge Database for Basin Water Resources Management 68

A. Senavirathne, M. Leh, K. Matheswaran, P. T. Prabhath, N. M. Velpuri and A. Seid

Data Quality as Part of the Model Performance: Benchmarking Missing-Value Imputation for Tropical Streamflow Prediction 69

A. H. Z. Aqthaf and R. L. H. L. Rajapakse

Performance Evaluation of Global Ensemble Forecast System (GEFS) Based Reservoir Inflow Forecasting for Almatti Reservoir, India 70

S. Saravanan, E. Arivoli, S. Joshi and K. Chandrasekar

Development of a National-Scale SMHI HYPE Model for Water Resources Assessment in Sri Lanka under Data-Scarce Conditions 71

K. Gangabadage, H. Amaguchi and Y. Imamura

Development of a Modified SCS Curve Number Method to Estimate Runoff in Small Catchments in Sri Lanka 72

H. H. U. Manjitha, G. M. C. A. Perera and H. G. L. N. Gunawardhana

Identifying Soil Erosion and Sediment Delivery Hotspots for Restoration Planning in the Upper Mahaweli Watershed, Sri Lanka 73

S. Dissanayaka, N. Eriyagama, L. Muthuwatta, T. Gurusinha and R. Jirasinha

Assessment of Contaminants That Inhibit Aquatic Plant Growth in Lanka Pond 74

N. Wijesekera, S. A. Witharana, S. Samaradiwakara and R. Weerasooriya

Planning of the Capacity Enhancement of Pahala Puliyankulama Tank: A Hydrological, Hydraulic and Environmental Assessment 75

D. M. T. P. Adikaram, H. G. L. N. Gunawardhana and R. L. H. L. Rajapakse

Reservoir Capacity Enhancement of a Minor Tank in Dry-Zone Sri Lanka: A Case Study of Pahala Kegama Wewa 76

D. A. I. B. Silva, H. G. L. N. Gunawardhana, R. L. H. L. Rajapakse, B. C. Dissanayake and C. Perera

Assessing Sustainability of the Lunugamwehera Reservoir in Sri Lanka 77

M. H. N. Nethmini and N. K. Gunasekara

Hydrogeological Feasibility of Sponge Zone Implementation for Urban Flood Resilience and Groundwater Recharge in Bangalore 78

R. Aswathanarayana and R. Gopinath

Enhancing Urban Stormwater Resilience through Surface Low Impact Development (LID) Measures: A Hydrological Assessment in Sri Lanka 79

M. E. Sutharsan and M. Shafique

Johads as Resilient Urban Water Bodies: Reimagining the Climate Discourse in India 80

P. Kumar

Integrating Digital Technologies and Nature-Based Solutions for Climate-Resilient Urban Water Infrastructure Planning in African Cities: A Conceptual Framework 81

G. Laolang and N. X. Mashwama

Thermal Spring Governance in Arid Regions: Community Perspectives and Local Governance at Al Hammam, Oman 82

A. A. Hanai, K. Alzeidi and R. A. Habsi

School-Based Citizen Science for Groundwater Awareness and Protection in the Jaffna Peninsula, Sri Lanka 83

D. S. E. Gamage, L. Muthuwatta, N. Eriyagama, D. Malalgoda, M. Karthikeyan, S. Shanmuhananthan, P. Suvasthigha, T. Sounthararajah, M. Aheeyar and R. Jirasinghe

Integration of Climate-Informed Flood Hazard Modelling and Community Perceptions for Adaptive Flood Risk Management in the Maha Oya River Basin, Sri Lanka 84

J. Vithurshika and G. M. C. A. Perera

Oral Presentations: Energy Track 85

Powering the Sustainable AI Future: Frugal Intelligence, Sustainable Energy, and Lifecycle Accounting at the Energy–Water Nexus 86

R. A. Prasath and R. Sivasubramaniam

Hierarchical Design of Heterojunction Photocatalysts for Efficient Solar Hydrogen Production 87

S. Pandey, M. D. Dhileepan, S. K. Lakhera, B. Neppolian and R. A. Prasath

Single-Mg-Doped, Organic Molecule Engineered g-C_3N_4 for Photoelectrocatalytic Coupled Phenol Degradation with Water Splitting 88

M. Premkumar, E. Pramila and D. S. Sharada

Development of LDH-MOF-5-Based Tunable Active Sites of Metal Nodes (Mo|Mn|Sn|Ag) for the Efficient Transesterification of *Picochlorum oklahomense* Lipids for Biodiesel Production 89

Mrinal and K. K. Jaiswal

Predictive AI and Reinforcement Learning for Autonomous Microgrid Energy Management in Rural Areas 90

A. Sharma, J. Petau, Ravikiran, R. Jayaramu, G. H. Klepp and S. Shamsundar

Microstructural Changes during Regeneration of Plaster of Paris Using Discarded Moulds 91

K. N. P. Thilakarathne, B. P. T. Rukmal, T. A. M. P. Ariyaratne and B. A. Karunaratne

Advantages of Integrating Circular Economy Concepts in Promoting Sustainable Construction 92

C. V. Rajasekara, U. M. S. Samararathne and W. N. Kawmudi

Footprint and Resource Decoupling in South Asian Economies: A Panel Data Approach 93

H. M. L. Abeyrathne

Sustainability and Resilience-Based Framework for Waste-Derived Microgrids 94

A. Deepak and A. Kumar

Development of an Energy Consumption Prediction Model for University Buildings 95

V. C. Jayalath, S. M. Pathirana and S. O. Dilshan

Techno-Economic Assessment of a Solar PV–Battery Energy Storage System for Peak Power and Demand Side Management in Indian Railways 96

D. Boruah

Solar-Integrated Hybrid Mechanical Ventilation for Energy-Resilient Office Buildings in Tropical Climates: A Simulation-Based Case Study in Jaffna, Sri Lanka 97

U. Thanapalasingam

Greening the Built Environment: Energy Efficiency and Sustainable Urban Transitions in Emerging Economies 98

S. Mukherjee

Integrating Energy Efficiency and Thermal Comfort in Educational Buildings: Evaluating Passive and Hybrid Strategies for Improved Performance in the Climatic Context of Coimbatore, India 99

N. Venkatramakrishnan and P. Sudhakaran

Sustainable Cost Control for Green Buildings in Sri Lanka: Integrating Life-Cycle Value and Environmental Performance 100

I. G. W. R. Jayaweera and K. A. P. B. K. Arachchi

Developing a Framework for Energy Efficiency and Climate Resilience in House Construction in Tropical Lowlands and Uplands 101

D. W. T. S. Dissanayake, H. G. L. N. Gunawardhana, C. Jayasinghe and R. Weerasinghe

Sustainable Integration of Rooftop Solar Photovoltaic Systems in Sri Lanka: Growth Drivers, Constraints, and Regulatory Priorities 102

S. A. C. Rajapaksa, H. P. R. C. Kumara

The Green Investment Paradox: Renewable Capacity, Institutional Quality, and the Limits of Productive Conversion in Morocco 103

K. Brhaiberh and M. Ziky

In Search of Clean Energy: India's Energy Diplomacy in the Global Disorder 104

A. Davis V

Design and Sizing of a Bamboo-Pellet-Fired Travelling-Grate Water-Tube Boiler and Integrated Steam Sterilization Chamber for Mushroom Growing-Media Sterilization 105

T. K. S. Pushpakumara, S. A. M. A. N. S. Senanayake and P. N. R. J. Amunugoda

Techno-Economic Feasibility of a Solar PV–Battery–Diesel Hybrid System for an Isolated Island Grid in Vanuatu 106

D. Boruah and P. Kumari

Design and Optimization of a Thermoelectric Generator for Waste Heat Recovery and Enhanced Green Energy Harvesting 107

Md. S. Mahmud, Md. M. Rahman, P. Saha, F. A. Farha, C. G. J. Prakash and P. Ravindran

Towards Equitable Residential Energy Systems: Exploring Justice in Residential Solar and Battery Storage Deployment 108

N. Jayaraj and S. Anandaraj

Assessment of Suitable Locations for Ocean Thermal Energy Conversion Development in Sri Lankan Waters 109

D. S. N. K. Sathsarani, W. A. A. P. Wijesundara and S. U. P. Jinadasa

PVsyst-Based Comparative Performance Assessment of Ground-Mounted and Rooftop Solar PV Systems in an Educational Institution 110

S. Aravindh, Kinley Om, R. B. R. Rex and R. A. Prasath

Poster Presentations 111

Financial Performance and Sustainability of Municipal Water Supply Infrastructure in Kandy City 112

H. D. Jayathilake

Satellite-Based Assessment of Drought Resilience of Small Reservoirs in the Dry Zone of Sri Lanka: A Case Study of the Mahakanumulla Village Tank Cascade System 113

S. A. C. D. Suraweera, R. S. R. Rubasinghe

Mechanistic Evidence of Hidden Heterotrophic Metabolic Capacity and a Narrow Respiratory Safety Margin in Microbialised Paraviwella Reef, Sri Lanka 114

V. Lageeshan[1,2], M. F. M. Fairoz[1]

After the Dam: Satellite-Based Assessment of Downstream Open-Water and Riparian-Corridor Greenness Following Moragahakanda Reservoir Impoundment, Sri Lanka 115

R. S. R. Rubasinghe, S. A. C. D. Suraweera

Climate-Informed Spillway Design under Climate Projection Uncertainty for Horuwila Wewa 116

Md. R. Hassan, C. Perera and N. Wijayaweera

Incorporating Dynamic Time of Concentration into Spillway Design under Future Climates: Knuckles Basin, Sri Lanka 117

S. T. Zaman, R. L. H. L. Rajapakse and N. K. Gunasekara

Quantifying Spillway Upgrades and Storage Expansion for Kattiyawa Wewa Reservoir under Future Climate Projections 118

S. Akhter, R. L. H. L. Rajapakse and A. H. R. Ratnasooriya

Uncertainty Analysis of Probability Distributions in Design Rainfall Estimation for Spillway Design 119

A. R. L. S. Alahakoon, T. M. N. Wijayaratna and H. G. L. N. Gunawardhana

Climate-Driven Rise in Consecutive Extreme Rainfall and Its Implications for Spillway Capacity: A Case Study in Manankattiya Reservoir, Sri Lanka 120

M. M. J. R. Malwattegedara, H. G. L. N. Gunawardhana and R. L. H. L. Rajapakse

Assessment of Design Flood Responses and Spillway Performances under Variations in Antecedent Soil Moisture Conditions, Rainfall Patterns and Hydrological Transformation Uncertainty in the Knuckles Basin 121

R. L. M. L. Rajasekara, P. K. C. De Silva and R. L. H. L. Rajapakse

Biomass-Derived Activated Carbons for CO_2 Capture: Preparation, Surface Engineering, Characterization, Adsorption Mechanisms and Industrial Applications 122

V. Ilamurugan, B. M. Jaffar Ali

From Plastic Waste to Circular Value: Open Innovation Pathways for a Resilient and Sustainable Sri Lanka 123

V. Sinnathamby

Promoting Urban Sustainability in Sri Lanka: The Role of Green Building Practices in Enhancing Environmental Health and Biodiversity 124

I. G. W. R. Jayaweera, K. A. P. B. K. Arachchi

Memories from ICEWSE 2026..... 125

FOREWORD: THE CONFERENCE

About ICEWSE 2026

The International Conference on Energy and Water for Sustainable Environment (ICEWSE) is a joint initiative of two UNESCO Chairs supported by the South Asia Foundation: the UNESCO Chair on Sustainable Water Resources Management in South Asia at the University of Moratuwa, Sri Lanka, and the UNESCO Chair on Renewable and Clean Energy for Sustainable Development at Pondicherry University, India. The inaugural conference, ICEWSE 2025, was held at Pondicherry University on 30 September and 1 October 2025, with 17 invited lectures and more than 140 contributed abstracts.

The second edition, ICEWSE 2026, is hosted by the UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM) at the Department of Civil Engineering, University of Moratuwa, on 5 and 6 October 2026. Its theme, Advancing the Energy–Water Nexus for a Sustainable and Resilient Future, reflects a simple dependency: producing energy requires water, treating and moving water requires energy, and both systems are exposed to the same climate risks. Planning in isolation is no longer adequate for South Asia.

The programme brings together keynote addresses, invited lectures and oral and poster presentations from researchers, practitioners and policymakers, organised in two tracks, Water and Energy. Together they address the Sustainable Development Goals on clean water and sanitation (SDG 6), affordable and clean energy (SDG 7), climate action (SDG 13) and partnerships (SDG 17).

2	2	23	100+	11
DAYS	TRACKS	THEMES	ABSTRACTS	COUNTRIES

WATER TRACK

- Aquifer Recharge & Floodplain Management
- Climate Resilience & Water Security
- Coastal & Marine Water Systems
- Geo-Hydro informatics & Decision Support Systems
- Groundwater Modelling & Disaster Resilience
- Groundwater Vulnerability & Climate Risk Reduction
- Hydrogeochemical Pathways for Sustainable Infrastructure
- Irrigation & Agricultural Water Management
- Nature-Based Water Solutions
- Remote Sensing, GIS & AI for Water
- Surface Water Hydrology & Basin Management
- Urban Water & Resilient Infrastructure
- Water Governance & Socio-Hydrology

ENERGY TRACK

- Advanced Energy Materials
- Artificial Intelligence for Renewable Energy
- Circular Economy and Sustainability
- Emerging Energy Technologies
- Energy Storage Technologies
- Green Buildings and Cities
- Green Energy and Sustainable Development
- Green Hydrogen and Fuel Cells
- Hydropower
- Renewable Energy Technologies
- Smart Grids and Energy Management Systems
- Energy Efficiency and Decarbonization Technologies
- Waste-to-Energy and Bioenergy Technologies

DOI: https://doi.org/10.31705/ICEWSE.2026



MESSAGE

Message from the Vice-Chancellor, University of Moratuwa

Senior Professor K. T. M. Udayanga Hemapala
Vice-Chancellor
University of Moratuwa, Sri Lanka

Engineering a Resilient Future through Knowledge and Partnership

The University of Moratuwa is proud to host ICEWSE 2026 – the 2nd International Conference on Energy and Water for a Sustainable Environment, bringing together researchers, professionals, policymakers, students, and international partners around two resources fundamental to sustainable development: water and energy.

The challenges before us are increasingly interconnected. Climate change, rapid urbanisation, growing resource demands, environmental degradation, and extreme events require solutions that extend beyond individual disciplines and national boundaries. Universities therefore have an important responsibility not only to generate knowledge, but also to create platforms through which research can influence technology, policy, infrastructure, and society.

ICEWSE 2026 provides such a platform. Its focus on water resources and climate resilience, sustainable energy technologies, and the water–energy nexus reflects the need for integrated thinking and collaborative action.

I am particularly pleased that this conference continues the partnership among the University of Moratuwa, Pondicherry University, the UNESCO Chairs, the South Asia Foundation, and associated institutions. Such collaborations strengthen regional academic networks and create opportunities for researchers and young professionals to address challenges of shared importance.

I encourage all participants, particularly postgraduate students and early-career researchers, to make full use of this opportunity to exchange ideas, question established approaches, and develop new partnerships.

I congratulate the organising team, contributing authors, reviewers, speakers, and supporting institutions for their commitment and collective effort.

May ICEWSE 2026 stimulate ideas that move beyond discussion and contribute meaningfully to a more resilient, sustainable, and resource-secure future.

Senior Professor K. T. M. Udayanga Hemapala
Vice-Chancellor
University of Moratuwa, Sri Lanka

DOI: https://doi.org/10.31705/ICEWSE.2026



MESSAGE

Message from the Dean, Faculty of Engineering

Professor J. M. A. Manatunge
Dean, Faculty of Engineering
University of Moratuwa, Sri Lanka

Transforming Research into Sustainable Engineering Solutions

Engineering today is being called upon to respond to challenges of unprecedented complexity. Water scarcity and flooding, climate uncertainty, increasing energy demand, environmental pressures, and rapidly changing technologies require solutions that are technically sound while remaining socially, economically, and environmentally sustainable.

Against this background, ICEWSE 2026 is particularly timely.

The Conference creates an important meeting point between research and practice by bringing together expertise in water resources, climate resilience, renewable energy, sustainable technologies, and the wider water–energy nexus. Its multidisciplinary character is especially valuable because many of today's engineering problems cannot be effectively addressed within conventional disciplinary boundaries.

For the Faculty of Engineering, such forums are central to our academic mission. Engineering education should equip graduates not only with analytical and technical capabilities, but also with the ability to understand complex systems, work collaboratively, and translate scientific knowledge into practical solutions.

ICEWSE also provides an excellent opportunity for postgraduate students and emerging researchers to present their work, receive critical feedback, engage with experienced professionals, and build collaborative networks that may extend well beyond the Conference.

The continuing partnership among the University of Moratuwa, Pondicherry University, the UNESCO Chairs, and the South Asia Foundation further demonstrates how regional academic cooperation can contribute to addressing shared sustainability challenges.

I congratulate everyone who has contributed to organising ICEWSE 2026 and warmly welcome all participants to the Faculty of Engineering.

I trust that the discussions and research presented here will generate new ideas, stronger partnerships, and practical pathways towards climate-resilient and sustainable engineering development.

Professor J. M. A. Manatunge
Dean, Faculty of Engineering
University of Moratuwa, Sri Lanka

DOI: https://doi.org/10.31705/ICEWSE.2026



MESSAGE

Message from the Head, Department of Civil Engineering

Professor U. P. Nawagamuwa
Head, Department of Civil Engineering
University of Moratuwa, Sri Lanka

Building Resilience through Water, Infrastructure and Innovation

For civil engineers, water has always been at the heart of infrastructure development and human settlement. Today, however, managing water has become inseparable from climate change, energy, urbanisation, ecosystem protection, and disaster resilience.

This makes ICEWSE 2026 highly relevant to both the academic community and engineering profession.

Changing rainfall patterns, floods, droughts, growing cities, increasing water demands, and pressure on natural resources are challenging conventional approaches to planning and design. At the same time, developments in modelling, monitoring, renewable energy, data science, and climate-risk assessment are opening new possibilities for more resilient and sustainable solutions.

The Department of Civil Engineering is pleased to support a conference that brings these perspectives together. The programme covering water resources and climate resilience alongside sustainable energy technologies provides an excellent opportunity to explore not only individual advances, but also the interactions among infrastructure, water, energy, environment, and society.

We are equally proud of the contribution made by the UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM) in promoting postgraduate education, research, regional cooperation, and professional capacity development.

I hope ICEWSE 2026 will encourage researchers to move beyond presenting results towards developing collaborations, testing ideas against practical experience, and identifying opportunities for implementation.

To our students and young researchers, this is also an opportunity to engage with specialists from different institutions and countries and to broaden your professional perspectives.

I congratulate the organising committee and warmly welcome all delegates to the Department of Civil Engineering and the University of Moratuwa.

Professor U. P. Nawagamuwa
Head, Department of Civil Engineering
University of Moratuwa, Sri Lanka

DOI: https://doi.org/10.31705/ICEWSE.2026



MESSAGE

Message from the Principal Trustee, Madanjeet Singh Foundation

Madam France Marquet
Principal Trustee
South Asia Foundation / Madanjeet Singh Foundation

Knowledge Without Borders: Strengthening South Asia through Cooperation

South Asia shares rivers, ecosystems, climate risks, development aspirations, and increasingly interconnected water and energy challenges. These shared realities remind us that meaningful and lasting solutions are best developed through cooperation, education, and mutual understanding.

ICEWSE 2026 beautifully reflects this spirit.

The South Asia Foundation (SAF) has always placed great value on bringing together young people, scholars, and institutions from across the region. The network of UNESCO Madanjeet Singh Institutions of Excellence was created with this very purpose: to use education and knowledge as bridges between countries and communities.

The partnership between the UNESCO Madanjeet Singh Centre for South Asia Water Management at the University of Moratuwa and the University of Madanjeet Singh Centre for Green Energy Technologies at Pondicherry University demonstrates how this vision can be translated into practical academic cooperation.

Water and energy are central to our region's future. They influence livelihoods, food security, health, economic development, environmental sustainability, and resilience to climate change. Bringing researchers and professionals together to discuss these challenges is therefore not only academically important, but also deeply relevant to society.

The vision of Late Shri Madanjeet Singh, UNESCO Goodwill Ambassador and SAF/MSF Founder, strongly emphasised regional understanding, peace, and collaboration through education. ICEWSE carries forward that vision by creating a shared intellectual space where ideas, experiences, and friendships can grow.

I congratulate everyone who has contributed to this second edition of the Conference and especially welcome the young researchers whose ideas will shape our future.

May ICEWSE 2026 strengthen professional partnerships, inspire new thinking, and contribute to a more cooperative, resilient, and sustainable South Asia.

Madam France Marquet
Principal Trustee
South Asia Foundation / Madanjeet Singh Foundation

DOI: https://doi.org/10.31705/ICEWSE.2026



MESSAGE

Message from UNESCO

Dr. Benno Böer
Programme Specialist and Chief of Sector for Natural Sciences
UNESCO New Delhi

Understanding Connections, Advancing Sustainability

Water, energy, climate, biodiversity, food, and human well-being are not separate systems. They are deeply interconnected, and decisions taken in one sector inevitably influence the others.

This systems perspective lies at the heart of sustainable development and gives ICEWSE 2026 particular significance.

Across South Asia, pressures from climate change, population growth, urbanisation, resource demand, and environmental degradation are becoming increasingly visible. Scientific research and technological innovation are essential in responding to these challenges, but they must be combined with education, effective institutions, international cooperation, and locally appropriate action.

By bringing together researchers working on water resources, climate resilience, renewable energy, environmental management, and sustainable technologies, ICEWSE provides an opportunity to explore these connections and move beyond fragmented approaches.

Universities and UNESCO Chairs have a particularly valuable role in this process. They connect research with education, build capacity among younger generations, strengthen international networks, and help translate global sustainability objectives into regional and local solutions.

It is encouraging to see the University of Moratuwa, Pondicherry University, the South Asia Foundation, and the participating UNESCO Chairs continuing this joint initiative following the inaugural conference.

I especially welcome the strong participation of students and early-career researchers. Their willingness to work across disciplinary and geographical boundaries will be crucial in developing the solutions required for the future.

I wish all participants productive discussions, new collaborations, and a successful conference.

May ICEWSE 2026 reinforce an essential message: sustainability depends on understanding connections—and acting upon them together.

Dr. Benno Böer
Programme Specialist and Chief of Sector for Natural Sciences
UNESCO New Delhi

DOI: https://doi.org/10.31705/ICEWSE.2026



MESSAGE

Message from the Conference Co-Chair and Convenor (Water)

Professor R. L. H. Lalith Rajapakse
Director/Centre Chair, UMCSAWM
UNESCO Chairholder – Sustainable Water Resources Management in South Asia
University of Moratuwa, Sri Lanka

Beyond the Water–Energy Nexus: From Knowledge to Action

ICEWSE was conceived around a simple idea: water and energy cannot be sustainably managed in isolation.

Their connections extend much further to climate resilience, food security, infrastructure, ecosystems, disaster risk, livelihoods, and economic development. The real challenge therefore lies not only in understanding the water–energy nexus, but in turning that understanding into practical solutions and measurable benefits for society.

Following the inaugural ICEWSE in India, it is a great privilege for us to host the second Conference at the University of Moratuwa, Sri Lanka.

ICEWSE 2026 brings together two closely connected themes: Water Resources and Climate Resilience and Sustainable Energy Technologies. Through keynote addresses, invited and special lectures, research presentations, and professional discussions, we hope to create meaningful interaction among scientists, engineers, practitioners, policymakers, and young researchers.

This Conference also reflects a much wider partnership. The collaboration among UMCSAWM, UMSGET, our two UNESCO Chairs, Pondicherry University, the University of Moratuwa, and the South Asia Foundation demonstrates the value of sustained regional academic cooperation.

I am deeply grateful to our speakers, authors, reviewers, institutional partners, sponsors, organising committee, staff, research assistants, students, and volunteers. Their commitment has made ICEWSE 2026 possible.

To our young researchers, I offer one particular encouragement: do not regard the Conference merely as a place to present completed work. Use it to challenge assumptions, develop partnerships, and identify how your research can contribute to real-world change.

Ultimately, the value of ICEWSE will be reflected not only in its proceedings, but in the ideas translated into action and collaborations that continue long after the Conference ends.

Professor R. L. H. Lalith Rajapakse
Director/Centre Chair, UMCSAWM
UNESCO Chairholder – Sustainable Water Resources Management in South Asia
University of Moratuwa, Sri Lanka



MESSAGE

Message from the Conference Co-Chair and Convenor (Energy)

Professor R. Arun Prasath

UNESCO Chairholder on Renewable and Clean Energy for Sustainable Development, Pondicherry University, India

I am deeply honored to welcome all delegates, speakers, researchers, students, and partners to the Second Joint International Conference on Energy and Water for Sustainable Environment (ICEWSE-2026), taking place on 5–6 October 2026 at the University of Moratuwa, Sri Lanka. Building on the success of ICEWSE-2025 at Pondicherry University, India, this event is jointly organized by both institutions under their respective UNESCO Chairs, Sustainable Water Resources Management, University of Moratuwa, and Renewable & Clean Energy for Sustainable Development, Pondicherry University, to advance regional cooperation, research, and innovation across the Energy–Water Nexus. The theme of ICEWSE 2026, "Advancing the Energy–Water Nexus for a Sustainable and Resilient Future," responds to escalating climate extremes and resource stress, underscoring the urgent need for integrated, climate-smart energy and water solutions. To solve linked problems in energy, water, climate resilience, and environmental sustainability, we must work together across fields and countries, living the idea of Vasudhaiva Kutumbakam, "the world is one family." The Conference therefore provides an opportunity for meaningful academic exchange on energy materials, renewable energy, green hydrogen and fuel cells, energy storage, climate action, sustainable cities, water security, recycled water, AI-enabled solutions, and emerging technologies.

As Convenor for the Energy Theme, I sincerely appreciate the leadership of the University of Moratuwa and Pondicherry University in continuing our vital partnership. ICEWSE 2026 offers a clear roadmap for future collaboration, fostering joint research, faculty-student exchanges, and capacity building while strengthening institutional linkages across SAF/MSF networks and South Asia. Organizing an event of this scale requires immense collective effort. I extend my sincere appreciation to the host, organizing committees, UNESCO Chairs, speakers, reviewers, authors, delegates, partners, and volunteers. I congratulate the University of Moratuwa team and am confident that ICEWSE 2026 will inspire rich intellectual engagement and foster collaboration.

I extend my heartfelt congratulations and very best wishes for a truly successful, impactful, and memorable ICEWSE 2026.

Professor R. Arun Prasath

UNESCO Chairholder on Renewable and Clean Energy for Sustainable Development,
Pondicherry University, India

DOI: https://doi.org/10.31705/ICEWSE.2026

HOST UNIVERSITY

University of Moratuwa, Sri Lanka



University of Moratuwa, Katubedda.

The University of Moratuwa is Sri Lanka's leading technological university, with a strong reputation for excellence in engineering, technology, architecture and applied sciences. Its origin lies in the Institute of Practical Technology established at Katubedda in 1960, which became the Ceylon College of Technology in 1966. It was raised to university status as the Katubedda Campus on 15 February 1972 and became the independent University of Moratuwa under the Universities Act No. 16 of 1978.

Set on the banks of the Bolgoda Lake, south of Colombo, the University today comprises the Faculties of Engineering, Architecture, Information Technology, Business, Medicine and Graduate Studies, together with the Institute of Technology. It serves more than 14,500 students and is widely regarded as the country's foremost producer of graduates in engineering, architecture, information technology and allied professions. Over the years, the University has also expanded its contribution to postgraduate education, multidisciplinary research and innovation in response to emerging national and global challenges.

Guided by its motto, "Wisdom is all Wealth", the University combines teaching and research of international standard with strong links to industry. Through applied research, consultancy, innovation, entrepreneurship and continuing professional education, it plays an important role in supporting technological advancement and national development. The University also maintains active academic and research collaborations with local and international institutions, strengthening its contribution to knowledge exchange and sustainable development.

ESTABLISHED	FACULTIES	DEPARTMENTS	MOTTO
1972	6	22	Wisdom is all Wealth

DOI: https://doi.org/10.31705/ICEWSE.2026

HOST CENTRE

UMCSAWM and the Department of Civil Engineering



Department of Civil Engineering Building at the University of Moratuwa.

UNESCO Madanjeet Singh Centre for South Asia Water Management

The UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM) is attached to the Department of Civil Engineering and supported by the South Asia Foundation (SAF). The Madanjeet Singh Building, inaugurated in 2013, was the first regional centre established to conduct full-time postgraduate degree programmes in water management for South Asia. Its vision is to promote regional cooperation through higher education and research of international standard in sustainable water resources management.

The Centre offers Master's (Mof) and Master of Science (MSc) programmes and a Postgraduate Diploma in Water Resources Engineering and Management (WREM)/Water Resources Management (WRM), admitting practising engineers from Sri Lanka alongside fully funded Madanjeet Singh scholars from SAARC countries. Across seven intakes, it has produced more than 60 Master's graduates and 32 postgraduate diploma holders, with over 1,750 problem-based learning projects. Research spans hydrological and watershed modelling, irrigation and urban water management, climate-driven flood risk, and water hazard and risk management.

Department of Civil Engineering

The Department of Civil Engineering is organised into six divisions: Building and Structural Engineering; Construction Engineering and Management; Environmental Engineering; Geotechnical Engineering; Hydraulic and Water Resources Engineering; and Transportation Engineering. Its BSc Engineering (Honours) degree is accredited by the Institution of Engineers Sri Lanka under the Washington Accord, and its postgraduate programmes cover structural design, geotechnics, transportation, environmental engineering, construction project management and water resources. Twelve members of its academic staff received President's Awards for Scientific Research in 2025.

DOI: https://doi.org/10.31705/ICEWSE.2026

UNESCO CHAIR · UNIVERSITY OF MORATUWA

UNESCO Chair on Sustainable Water Resources Management in South Asia

The UNESCO Chair on Sustainable Water Resources Management in South Asia was established at the University of Moratuwa in recognition of a decade of regional water education delivered through UMCSAWM. As part of the UNITWIN/UNESCO Chairs Programme, the Chair builds on the Centre's postgraduate programmes to strengthen research, training and knowledge-sharing on sustainable water management across South Asia. Its founding Chairholder is Professor R. L. H. Lalith Rajapakse.

OBJECTIVES

- Promote South Asian cooperation in integrated water resources management for sustainable development.
- Conduct international programmes in sustainable water management that equip participants with problem-solving skills.
- Award eight full-time scholarships each year for research on sustainable water resources management.
- Establish experimental research facilities and conduct field-based research on water management.

CORE ACTIVITIES

- **Postgraduate teaching:** MSc and diploma programmes in Water Resources Engineering and Management
- **Short-term training** for water management practitioners
- **Research** through Master's theses and the dissemination of publications
- **Visiting professorships** and academic exchange
- **Scholarships:** eight SAF-sponsored Master's scholarships a year for SAARC countries
- **Institutional development** of facilities and partner collaborations



UMCSAWM, University of Moratuwa.

DOI: https://doi.org/10.31705/ICEWSE.2026

THE CHAIRHOLDER

Professor R. L. H. Lalith Rajapakse



UNESCO CHAIRHOLDER

Director / Centre Chairman, UMCSAWM (since 2018)
Professor in Civil Engineering, UoM (since 2019)
Conference Chair and Convenor (Water), ICEWSE 2026
BSc Eng (Hons), MSc, PhD, CEng, MIE (SL)

Professor R. L. H. Lalith Rajapakse is the founding holder of the UNESCO Chair on Sustainable Water Resources Management in South Asia and has led the UNESCO Madanjeet Singh Centre for South Asia Water Management as Director and Centre Chairman since 2018. Under his leadership the Centre has widened the international reach of its postgraduate programmes and strengthened its research, training and regional partnerships.

He graduated with a BSc in Civil Engineering with First Class Honours from the University of Moratuwa in 1996, and obtained an MSc in Civil and Environmental Engineering (Hydroscience and Geotechnology) in 1999 and a PhD in Environmental Science and Technology (Environmental Hydraulics and Ecological Engineering) in 2005 from Saitama University, Japan. He was subsequently a JSPS Postdoctoral Research Fellow at Saitama University and a Specialist Researcher at the UNESCO International Centre for Water Hazard and Risk Management (ICHARM), Japan, having earlier worked as a Planning Engineer with Jan De Nul in Singapore.

His research covers surface and groundwater hydrology and environmental ecology, including watershed management, hydrological modelling, flood and inundation analysis, ecological engineering, sediment transport and basin-scale pollution management, with contributions to river engineering, floodplain management and flood forecasting. He is a Chartered Engineer and Member of the Institution of Engineers Sri Lanka, and his recent work with students and colleagues on climate change impacts, artificial intelligence in hydrology and flood risk assessment has received several best paper awards.

1996	BSc Eng (First Class Hons), University of Moratuwa	**2007**	Specialist Researcher, UNESCO-ICHARM, Japan
1999	MSc, Saitama University, Japan	**2018**	Director / Centre Chairman, UMCSAWM
2005	PhD, Saitama University, Japan	**2019**	Professor in Civil Engineering, UoM
2006	JSPS Postdoctoral Fellow, Saitama University	**2023**	Founding UNESCO Chairholder

DOI: https://doi.org/10.31705/ICEWSE.2026

THE CHAIRHOLDER

Professor R. Arun Prasath



UNESCO CHAIRHOLDER

Renewable and Clean Energy for Sustainable Development, Pondicherry University (since 2024)

Professor, Pondicherry University (since 2021)

Conference Co-Chair and Convenor (Energy), ICEWSE 2026

BSc, MSc, PhD

Prof. Ramaswamy Arun Prasath is the founding holder of the UNESCO Chair on Renewable and Clean Energy for Sustainable Development and was Head of the Department of Green Energy Technology from 2023 to 2026. During his tenure, the department introduced the B.Tech Energy Science and Technology program and expanded international collaborations. With over 22 years of teaching, research, and industrial research experience, he has authored more than 67 peer-reviewed publications and 17 book chapters, and is a co-inventor on three international patents and two European patent applications.

He received his B.Sc. and M.Sc. degrees from Bharathiar University and his Ph.D. from Anna University. He has held prestigious research fellowships, including DAAD (Germany), BOF (Belgium), and Raman (USA), and has gained research experience at the Max Planck Institute for Polymer Research, IISc Bangalore, the University of Strathclyde, the University of New South Wales (Australia), Ghent University, and the University of Wyoming. His research focuses on advanced materials for solar cells, green hydrogen, bioenergy, batteries, and fuel cells.

Prof. R. Arun Prasath has led several national sustainability initiatives, including the Solar Campus Master Plan (2013), Green Campus Auditing, Sustainability@PU, and Pondicherry University's Net Zero Carbon by 2035 Mission. Under the UNESCO Chair, he has organized 11 high-impact international and national events on green energy, green hydrogen, nuclear–clean hydrogen synergy, ocean energy, clean water, and sustainable development.

1993	BSc Science, Bharathiar University, India
1995	MSc, Bharathiar University, India
2001	Ph.D, Anna University, India [DAAD Fellow (1999-2001), MPIP, Germany]
2002	Research Associate, Indian Institute of Science, India
2004	Postdoctoral Fellow, University of Strathclyde, United Kingdom
2006	Postdoctoral Fellow, University of New South Wales, Australia
2008	BOF Senior Researcher, Ghent University, Belgium
2010	Assistant Professor, Pondicherry University, India
2014	UGC-RAMAN postdoctoral fellowship, University of Wyoming, USA
2021	Professor, Pondicherry University, India
2023	Head, Department of Green Energy Technology, Pondicherry University, India
2024	Founding UNESCO Chairholder on RCESD

DOI: https://doi.org/10.31705/ICEWSE.2026

COLLABORATING UNIVERSITY

Pondicherry University, UMSGET and the UNESCO Chair on RCESD

Pondicherry University, established in 1985, is a Central University of India with a green campus of about 880 acres in Puducherry and off-campus centres in Port Blair and Karaikal. Its 15 schools and 38 departments offer more than 140 postgraduate and research programmes.

The Department of Green Energy Technology was established in 2010 under the UNESCO Madanjeet School of Green Energy Technologies (UMSGET) with the support of the South Asia Foundation. It offers an M.Tech in Green Energy Technology and doctoral research in renewable energy, and is recognised by India's Ministry of New and Renewable Energy as a nodal centre for clean energy.

The UNESCO Chair on Renewable and Clean Energy for Sustainable Development (RCESD) was established at Pondicherry University for 2024–2028 and inaugurated on 10 December 2024 as the sixteenth UNESCO Chair in India, with the support of UNESCO, the Ministry of Education, Government of India, and the Madanjeet Singh Foundation and South Asia Foundation. It promotes research, education, and capacity-building in renewable energy across South Asia.



ICEWSE 2025, the inaugural conference, at Pondicherry University, India (30 September – 1 October 2025)

DOI: https://doi.org/10.31705/ICEWSE.2026

SUPPORTING FOUNDATION

South Asia Foundation (SAF) and Madanjeet Singh Foundation (MSF)

Founded in 2000 by the late UNESCO Goodwill Ambassador Madanjeet Singh, the South Asia Foundation (SAF) is a secular, non-profit and non-political organisation in official relations with UNESCO, with autonomous chapters in Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

SAF's core objective is to promote regional cooperation and peace through education. It does so by supporting UNESCO Madanjeet Singh Institutions of Excellence across the eight SAARC countries and by funding Madanjeet Singh scholarships for students from the region. The Madanjeet Singh Foundation (MSF), led by its Principal Trustee, Madam France Marquet, supports this mission. ICEWSE is organised jointly by two of these institutions: UMCSAWM in Moratuwa and UMSGET in Puducherry.

UNESCO MADANJEET SINGH INSTITUTIONS OF EXCELLENCE

Preservation of Cultural Heritage
Kabul, Afghanistan

Human Rights and Common Law
Dhaka, Bangladesh

Forestry Studies
Bumthang, Bhutan

Journalism
Chennai, India

Kashmir Studies
Srinagar, India

Regional Cooperation
Puducherry, India

Green Energy Technology
Puducherry, India

Climate Research
Maldives

Development Studies
Kathmandu, Nepal

Visual ArtS
Lahore, Pakistan

South Asian Studies
Lahore, Pakistan

Water Management
Moratuwa, Sri Lanka



The ceremonial lamp-lighting during inauguration of UMCSAWM, University of Moratuwa (2013)

DOI: https://doi.org/10.31705/ICEWSE.2026

ICEWSE 2026

Organising Committee

UNIVERSITY OF MORATUWA · HOST

CHIEF PATRON
Professor K. T. M. Udayanga Hemapala
Vice-Chancellor, University of Moratuwa
UoM, Sri Lanka

GUEST OF HONOUR
Madam France Marquet
Principal Trustee
SAF/MSF

PATRON
Professor J. M. A. Manatunge
Dean, Faculty of Engineering
UoM, Sri Lanka

PATRON
Prof. P. Natarajan
Director (i/c), Culture and Cultural Relations
Pondicherry University, India

PATRON
Mr. S. K. Rodrigo
Acting Bursar, Finance Division
UoM, Sri Lanka

PATRON
Dr. N. A. I. D. Nissanka
Director, Postgraduate Studies Division
UoM, Sri Lanka

PATRON
Professor U. P. Nawagamuwa
Head, Department of Civil Engineering
UoM, Sri Lanka

PATRON
Mr. D. L. D. Jayantha
Registrar
UoM, Sri Lanka

PATRON
Mrs. R. C. Kodikara
Librarian
UoM, Sri Lanka

PATRON
Dr. G. V. I. Samaradivakara
Director, International Relations
UoM, Sri Lanka

CONFERENCE CO-CHAIRS & CONVENORS
Professor R. L. H. Lalith Rajapakse
Dept. of Civil Eng., Director of UMCSAWM · UNESCO Chairholder on SWRMSA, UoM

Professor R. Arun Prasath
UNESCO Chairholder on RCESD, PU

UOM PROGRAMME COORDINATORS

Mr. Harsha Ratnasooriya
Senior Lecturer, UoM

Dr. Luminda Gunawardhana
Senior Lecturer, UoM

Mr. Nalintha Wijayaweera
Lecturer (On Contract), UoM

Dr. Nimal Wijayaratna
Senior Lecturer, UoM

Dr. Chatura Dissanayake
Senior Lecturer, UoM

Dr. Kasun De Silva
Senior Lecturer, UoM

Dr. Chamal Perera
Lecturer, UoM

ICEWSE 2026

Programme Advisory Committee

SAF – SRI LANKA
Prof. R. L. H. L. Rajapakse
Dept. of Civil Eng., Director of UMCSAWM, UNESCO Chairholder on SWRMSA, UoM

SAF – INDIA
Prof. R. Arun Prasath
UNESCO Chairholder on RCESD, UMGET, Pondicherry University

SAF – INDIA
Prof. B. M. Jaffar Ali
DEAN, MSGET, Department of Green Energy Technology, Pondicherry University, India

SAF – BANGLADESH
Dr. Md. Zakaria
SAF Secretary – Bangladesh Chapter

SAF – NEPAL
Dr. Nischal N. Pandey
Chairperson, SAF – Nepal Chapter

SAF – BHUTAN
Dr. Nima Gyeltshen
SAF Secretary – Bhutan Chapter

ABSTRACT REVIEW COMMITTEE

Ms. Anoma Srimali	University of Moratuwa, Sri Lanka
Prof. R. Arun Prasath	Pondicherry University, India
Mr. Avintha Senavirathna	International Water Management Institute, Sri Lanka
Ms. Cabila Subramaniyam	Tokyo Metropolitan University, Japan
Mr. Chamal Jayaminda	Swansea University, United Kingdom; Université Grenoble Alpes, France
Dr. Chatura Dissanayake	University of Moratuwa, Sri Lanka
Mr. Harsha Abeykoon	National Water Supply and Drainage Board, Sri Lanka
Dr. Janaka Bamunawala	Tohoku University, Japan
Ms. Jayani Malwattegedara	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Ms. Jithmi Thisurika	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Dr. Kasun De Silva	University of Moratuwa, Sri Lanka
Ms. Kavindya Wijayarathna	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Ms. Kavini Gangabadage	Tokyo Metropolitan University, Japan
Mr. Kumudu Madhawa	Tohoku University, Japan
Ms. Lihini Alahakoon	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Mr. Lumin Gunasinghe	Geoton Pty Ltd, Australia
Dr. Luminda Gunawardhana	University of Moratuwa, Sri Lanka
Ms. Maduri Lakshika	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Prof. Mohan Amarasiri	Tohoku University, Japan
Ms. Nadee Kaushalya	Tohoku University, Japan
Mr. Nalintha Wijayaweera	University of Moratuwa, Sri Lanka
Ms. Oshara Sandamini	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Ms. Paboda Jayawardane	University of Moratuwa, Sri Lanka
Mr. Rakib Hassan	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Mr. Ravindu Madhumal	National University of Singapore
Mr. Sadeepa Karunarathna	United Arab Emirates University, UAE
Ms. Sanduni Subasinghe	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka

DOI: https://doi.org/10.31705/ICEWSE.2026

Mr. Sasanka Nanayakkara	University of Moratuwa, Sri Lanka
Ms. Shahrin Akhter	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Mr. Suraj Tharuka	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Mr. Takrim Zaman	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Ms. Tharindi Wijekoon	Adelaide University, Australia
Mr. Tharindu Disanayake	University of Moratuwa, Sri Lanka
Ms. Tharuka Heshani	Lanka Hydraulic Institute Ltd, Sri Lanka
Mr. Thushan Chamika	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Mr. Umal Manjitha	University of Moratuwa, Sri Lanka
Mr. Wasitha Dilshan	Tohoku University, Japan
Mr. Wenusha Senarathna	UNESCO Madanjeet Singh Centre for South Asia Water Management, Sri Lanka
Mr. Zafar Aqthaf	University of Moratuwa, Sri Lanka

DOI: https://doi.org/10.31705/ICEWSE.2026

ICEWSE 2026

Organising Committee Members

The conference was delivered by the following sub-committees, drawn from the academic staff, research assistants, and postgraduate students of UMCSAWM and the Department of Civil Engineering, University of Moratuwa.

Scientific Programme & Peer Review *Abstract reviews, session allocations, panel appointments, scoring criteria, and DOI allocation*	**Lead:** *Dr. Luminda Gunawardhana* **Members:** *Dr. Chamal Perera, Ms. Kavindya Wijayarathna, Ms. Nadee Kaushalya, Mr. Suraj Tharuka, Mr. Zafar Aqthaf*
Editorial & Publication Management *Book of abstracts, detailed programme schedule, print proofs, and ISSN liaison*	**Lead:** *Ms. Kavindya Wijayarathna* **Members:** *Ms. Sanduni Subasinghe, Mr. Umal Manjitha, Mr. Wenusha Senarathna*
Graphic Design & Branding *Logo, invitations, posters, banners, name tags and souvenirs*	**Lead:** *Mr. Thushan Chamika* **Members:** *Ms. Sanduni Subasinghe, Ms. Kavindya Wijayarathna, Mr. Wenusha Senarathna*
Transport, Fleet & Protocol Logistics *Airport pickups/drop-offs, vehicle coordination, route planning, and VIP guest transfers*	**Lead:** *Mr. Wajira Kumarasinghe, Mr. Umal Manjitha* **Members:** *Mr. Wenusha Senarathna, Mr. Thushan Chamika, Mr. Zafar Aqthaf, Mr. Chamod Wijesiri*
Stage, Venue Branding & Exhibition *Backdrops, banner placement, stage setup, flags and sponsorship stalls*	**Lead:** *Mr. Wenusha Senarathna* **Members:** *Dr. Kasun De Silva, Mr. Thushan Chamika, Mr. R. S. S. Ranaweera*
Venue Facilities & Technical Support *Auditorium, AV systems, hybrid sessions, maintenance and utilities*	**Lead:** *Dr. Chatura Dissanayake* **Members:** *Dr. Kasun de Silva, Mr. Thushan Chamika, Mr. Wenusha Senarathna, Mr. R. S. S. Ranaweera, Mr. W. R. Wijeweerathe*
Web, Media & Communications *Website, social media, press and photography*	**Lead:** *Mr. W. P. Wijeweera* **Members:** *Mr. Thushan Chamika, Mr. Wenusha Senarathna, Mr. Umal Manjitha*
Registration & Delegate Services *Registration desk, delegate lists, certificates and conference kits*	**Lead:** *Ms. Oshara Sandamini* **Members:** *Ms. Jithmi Thisurika, Ms. Sanduni Subasinghe, Ms. Lihini Alahakoon, Ms. Maduri Lakshika, Ms. Shahrin Akhter, Mr. Takrim Zaman*
Hospitality, Cultural & Social Events *Guest reception, refreshments, cultural event, gala dinner*	**Lead:** *Mrs. K. A. V. Kalanika* **Members:** *Ms. Sanduni Subasinghe, Mrs. L. J. N. Silva, Ms. Kavindya Wijayarathna, Mr. Samantha Ranaweera, Mr. Umal Manjitha*
Finance & Accounts *Budget, payments, sponsorship and reporting*	**Lead:** *Dr. Chamal Perera* **Members:** *Mrs. K. A. V. Kalanika, Mrs. L. J. N. Silva, Ms. M. M. J. R. Malwattegedara*

DOI: https://doi.org/10.31705/ICEWSE.2026

05 – 06 OCTOBER 2026

Programme at a Glance

Main Auditorium, Department of Civil Engineering, University of Moratuwa. Times are in Sri Lanka Standard Time and may be subject to change.

DAY 01	MONDAY, 05 OCTOBER 2026
08:00 – 08:30	**Registration**
08:30 – 10:20	**Opening Ceremony** *Main Auditorium*
10:20 – 10:40	High Tea and Poster Presentations
10:40 – 11:10	**Keynote Speech · Water Sector** *Dr. Mareledi Gina Maswabi, Commonwealth National Climate Finance Adviser – Sri Lanka*
11:10 – 11:30	**Invited Lecture · Water Sector** *Dr. R.M.M. Pradeep, General Sir John Kotelawala Defence University*
11:30 – 12:30	**Parallel Oral Sessions · Session 1** *Groundwater and Catchment Hydrology; Water Quality Assessment and Improvement; Climate and Hazard Risk Assessment (online)*
12:30 – 13:30	Lunch Break and Poster Display
13:30 – 14:00	**Keynote Speech · Energy Sector** *Prof. Arun Prasath, UNESCO Chair RCESD, Pondicherry University, India*
14:00 – 15:00	**Invited Lectures · Energy & Water Sectors** *Prof. B.M. Jaffar Ali; Prof. D.S. Sharada; Dr. Chamal Perera*
15:00 – 16:10	**Parallel Oral Sessions · Session 2** *Renewable Energy Technologies; Sustainable Materials for Water Treatment; Planning for Water Security (online)*
16:10 – 16:20	**Guest Speech** *Dr. Harith Wickrema, Founder, Planet Green Force*
16:20 – 16:40	Tea Break and Poster Display
16:40 – 17:45	**Parallel Oral Sessions · Session 3** *Hydrological Assessment for Water Resources Planning; Water Quality Monitoring and Assessment (online); Sustainable Energy Solutions (online)*
19:00 onwards	**Gala Dinner** *Ramadia Ranmal Holiday Resort*

DOI: https://doi.org/10.31705/ICEWSE.2026

DAY 02	TUESDAY, 06 OCTOBER 2026
08:15 – 08:30	**Welcome · Day 2**
08:30 – 09:00	**Keynote Speech · Energy Sector** *Prof. Asanka Rodrigo, Department of Electrical Engineering, University of Moratuwa*
09:00 – 09:40	**Invited Lectures · Energy & Water Sectors** *Nepal floods and the Bhote Koshi–Rasuwa disaster: Mr. Pradeep Raj Pandey; Ms. Utsaha Pahadi*
09:40 – 10:10	Tea Break and Poster Presentations
10:10 – 11:20	**Parallel Oral Sessions · Session 1** *Climate Extremes and Disaster Risk; Flood and Runoff Analysis; Water Resources Assessment and Management (online)*
11:20 – 11:50	**Keynote Speech · Water Sector** *Prof. K. Srinivasamoorthy, Department of Earth Sciences, Pondicherry University*
11:50 – 12:30	**Invited Lectures · Water & Energy Sectors** *Dr. Kasun De Silva; Dr. S. Sivasankari*
12:30 – 13:30	Lunch Break and Poster Evaluation Session
13:30 – 13:50	**Invited Lecture · Energy Sector** *Dr. Krishna Kumar Jaiswal, Pondicherry University*
13:50 – 15:20	**Parallel Oral Sessions · Session 2** *Sustainable Energy and the Water–Energy Nexus; Sustainable Energy for Buildings and Infrastructure (online); Water Security and Climate Resilience*
15:20 – 15:40	Tea Break
15:40 – 16:00	**Invited Lecture · Water Sector** *Dr. E. Yuvaraj, Pondicherry University*
16:00 – 17:10	**Parallel Oral Sessions · Session 3** *Hydrological Modelling and Water Resources; Sustainable Energy and Resource Transitions (online); Agricultural Water Management*
17:10 – 18:00	**Cultural Programme, Valedictory Session and Certificate Distribution**

DOI: https://doi.org/10.31705/ICEWSE.2026

DAY 01 · 05 OCTOBER 2026

Opening Ceremony

08:00 – 08:30	**Registration**
08:30 – 08:40	**Ceremonial Welcome Procession for Guests and Invitees**
08:40 – 08:50	**Lighting of the Oil Lamp**
08:50 – 08:55	**National Anthem**
08:55 – 09:10	**Welcome Address** *Prof. Lalith Rajapakse, Chairman of UMCSAWM, University of Moratuwa, Sri Lanka and Prof. R. Arun Prasath, UNESCO Chair RCESD, Pondicherry University, India*
09:10 – 09:15	**Pooja Dance**
09:15 – 09:25	**Address by Prof. U. P. Nawagamuwa** *Head, Department of Civil Engineering, UoM*
09:25 – 09:35	**Address by Prof. Jagath Manatunge** *Dean, Faculty of Engineering, UoM*
09:35 – 09:45	**Address by Senior Prof. K. T. M. U. Hemapala** *Vice-Chancellor, University of Moratuwa*
09:45 – 09:55	**Address by H.E. Madam Chandrika Bandaranaike Kumaratunga** *Inaugural SAF Chairperson, SAF-Sri Lanka, and Former Executive President of Sri Lanka*
09:55 – 10:05	**Dance Performance**
10:05 – 10:15	**Address by Madam France Marquet** *Principal Trustee, Madanjeet Singh Foundation / SAF*
10:15 – 10:20	**Message from UNESCO** *Dr. Benno Böer, Programme Specialist and Chief of Sector for Natural Sciences, UNESCO New Delhi*
10:20 – 10:40	**Tea and Poster Presentations**

DOI: https://doi.org/10.31705/ICEWSE.2026

05 – 06 OCTOBER 2026

Technical Sessions and Session Chairs

Parallel oral sessions run in the Main Auditorium, the Transport PG Room and the Structural PG Room, Department of Civil Engineering. Each oral presentation is 10 minutes.

DAY 01 MONDAY, 05 OCTOBER 2026

ROOM · MODE	SESSION THEME · ABSTRACTS	SESSION CHAIRS
SESSION 1 11:30 – 12:30		
Main Auditorium In person	Groundwater and Catchment Hydrology WAT-82, WAT-123, WAT-40, WAT-85, WAT-83	Dr. Nimal Wijayaratna (UoM) Dr. Nilupul Gunasekara (KDU)
Transport PG Room In person	Water Quality Assessment and Improvement WAT-94, WAT-126, WAT-109, WAT-97, WAT-26	Dr. Sachithra Imbulana (UoM) Dr. Kasun De Silva (UoM)
Structural PG Room Online	Climate and Hazard Risk Assessment WAT-63, WAT-06, WAT-92, WAT-120, WAT-29, WAT-103	Dr. Luminda Gunawardhana (UoM) Dr. Chatura Dissanayake (UoM)
SESSION 2 15:00 – 16:10		
Main Auditorium In person	Renewable Energy Technologies EN-01, EN-53, EN-21, EN-37, EN-51	Prof. R. Arun Prasath (PU) Dr. Shakila Pathirana (UoK)
Transport PG Room In person	Sustainable Materials for Water Treatment WAT-127, WAT-110, WAT-115, WAT-128	Dr. Sachithra Imbulana (UoM) Dr. Chamal Perera (UoM)
Structural PG Room Online	Planning for Water Security WAT-54, WAT-13, WAT-87, WAT-130, WAT-100	Dr. Luminda Gunawardhana (UoM) Dr. Chatura Dissanayake (UoM)
SESSION 3 16:40 – 17:45		
Main Auditorium In person	Hydrological Assessment for Water Resources Planning WAT-10, WAT-50, WAT-32, WAT-129, WAT-45	Prof. Lalith Rajapakse (UoM) Dr. Chamal Perera (UoM)
Transport PG Room Online	Water Quality Monitoring and Assessment WAT-90, WAT-44, WAT-101, WAT-88, WAT-73	Dr. Luminda Gunawardhana (UoM) Ms. Sudhara Gallage (UoM)
Structural PG Room Online	Sustainable Energy Solutions EN-04, EN-47, EN-19, EN-52	Dr. S. Sivasankari (PU) Dr. Krishna Kumar Jaiswal (PU)

DOI: https://doi.org/10.31705/ICEWSE.2026

DAY 02 TUESDAY, 06 OCTOBER 2026

ROOM · MODE	SESSION THEME · ABSTRACTS	SESSION CHAIRS
SESSION 1 10:10 – 11:20		
Main Auditorium In person	**Climate Extremes and Disaster Risk** WAT-84, WAT-125, WAT-28, WAT-31, WAT-99	Prof. Lalith Rajapakse (UoM) Dr. Chamal Perera (UoM)
Transport PG Room In person	**Flood and Runoff Analysis** WAT-61, WAT-24, WAT-78, WAT-124, WAT-09	Dr. Kasun De Silva (UoM) Mr. Nalintha Wijayaweera (UoM)
Structural PG Room Online	**Water Resources Assessment and Management** WAT-76, WAT-25, WAT-86, WAT-42, WAT-48	Dr. Luminda Gunawardhana (UoM) Dr. Chatura Dissanayake (UoM)
SESSION 2 13:50 – 15:20		
Main Auditorium In person	**Sustainable Energy and the Water–Energy Nexus** EN-20, EN-43, EN-06, EN-56, EN-55, WAT-57	Prof. B.M. Jaffar Ali (PU) Prof. D.S. Sharada (PU)
Transport PG Room Online	**Sustainable Energy for Buildings and Infrastructure** EN-31, EN-12, EN-33, EN-46, EN-14, EN-50	Dr. S. Sivasankari (PU) Dr. Krishna Kumar Jaiswal (PU)
Structural PG Room In person	**Water Security and Climate Resilience** WAT-105, WAT-41, WAT-93, WAT-91, WAT-118, WAT-111	Dr. Luminda Gunawardhana (UoM) Dr. Chamal Perera (UoM)
SESSION 3 16:00 – 17:10		
Main Auditorium In person	**Hydrological Modelling and Water Resources** WAT-68, WAT-98, WAT-55, WAT-46, WAT-78	Dr. Kasun De Silva (UoM) Dr. Luminda Gunawardhana (UoM)
Transport PG Room Online	**Sustainable Energy and Resource Transitions** EN-17, EN-40, EN-35, EN-15, EN-10	Dr. S. Sivasankari (PU) Dr. Krishna Kumar Jaiswal (PU)
Structural PG Room In person	**Agricultural Water Management** WAT-80, WAT-95, WAT-70, WAT-38, WAT-72	Dr. Chamal Perera (UoM) Dr. Chatura Dissanayake (UoM)

SECTION

01

Keynote Addresses

KEYNOTE SPEAKERS

CODE	TIME	KEYNOTE SPEAKER
DAY 01 · MONDAY, 05 OCTOBER		
KN01 WATER	10:40 – 11:10	**Dr. Mareledi Gina Maswabi** *Commonwealth National Climate Finance Adviser, Sri Lanka* Water, Climate and Future of Resilience: Rethinking Sustainable Development in South Asia
KN02 ENERGY	13:30 – 14:00	**Prof. R. Arun Prasath** *UNESCO Chair RCESD, Pondicherry University, India* Materials for Renewable Energy Harvesting and Storage: Fostering Renewable Energy at HEIs for a Sustainable Environment
DAY 02 · TUESDAY, 06 OCTOBER		
KN03 ENERGY	08:30 – 09:00	**Prof. Asanka Rodrigo** *Department of Electrical Engineering, University of Moratuwa, Sri Lanka* Energy Transitions for Environmental Resilience: Integrating Smart Grids for a Net-Zero Future
KN04 WATER	11:20 – 11:50	**Prof. K. Srinivasamoorthy** *Department of Earth Sciences, Pondicherry University, India* Integrated Multi-Proxy Techniques for Assessing Submarine Groundwater Discharge and Saline Intrusion along the Coastal Tracts of South-Eastern India: Implications for Sustainable Water Resources

KN01 KEYNOTE ADDRESS · WATER SECTOR

Water, Climate and Future of Resilience: Rethinking Sustainable Development in South Asia

M. G. Maswabi[1*]

[1]*Commonwealth National Climate Finance Access Hub, Sri lanka*

**Corresponding author: g.maswabi@commonwealthconnect.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.1

Abstract

Climate change is reshaping the conditions for sustainable development, with water at the centre of interconnected risks affecting food, energy, ecosystems, infrastructure and livelihoods across South Asia. Building resilience therefore requires moving beyond isolated technical solutions and projects towards more integrated approaches to planning, investment and implementation. This keynote explores two critical shifts. First, resilience requires institutional integration: climate and water risks are systemic, yet development planning and investment decisions often remain organised around sectoral mandates. Second, financing resilience requires moving from project pipelines to investment pathways that connect risk and evidence with policy priorities, investment planning, appropriate financing, implementation and scale. Drawing on emerging experiences from South Asia, the keynote considers how stronger institutional integration and more strategic approaches to finance can help translate knowledge and innovation into resilient development outcomes. It argues that resilience is not simply a project to be financed, but a development pathway to be deliberately shaped and sustained.

Keywords: *climate finance; climate resilience; institutional integration; investment pathways; South Asia; sustainable development; water security*

KN02 KEYNOTE ADDRESS · ENERGY SECTOR

Materials for Renewable Energy Harvesting and Storage: Fostering Renewable Energy at HEIs for a Sustainable Environment

R. A. Prasath[1*]

[1]*Laboratory for Energy Materials and Sustainability, Department of Green Energy Technology, Madanjeet School of Green Energy Technologies, Pondicherry University, Puducherry, India*

**Corresponding author: raprasath@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.2

Abstract

The transition towards renewable energy systems requires materials capable of efficiently harvesting, converting and storing energy while supporting sustainable and low-carbon development. This presentation highlights research and technological developments in nanostructured, polymeric, inorganic, and hybrid materials for renewable energy harvesting, energy conversion, and energy storage applications from my research group. The presentation will emphasize (i) nanostructured TiO_2-based materials developed through microwave-assisted sol–gel synthesis for enhanced sunlight harvesting and photovoltaic applications, (ii) integration of broadband plasmonic Au and Ag nanostructures with mesoporous TiO_2 for enhanced solar absorption and an improvement in the power conversion efficiency of dye-sensitized solar cells, (iii) the development of solid-state polymer–inorganic composite electrolytes incorporating GARNET fillers and cross-linked polymer networks to enhance lithium-ion transport, interfacial stability and electrochemical safety while suppressing dendrite formation, providing opportunities for next-generation high-energy solid-state batteries, (iv) polymer-encapsulated phase change materials (PCMs) for solar-thermal energy storage, offering improved thermal charging–discharging characteristics and latent heat capacity, (v) high-solar-reflectance, water-based roof-cool coatings will also be highlighted as a passive cooling approach for reducing solar heat absorption and indoor cooling demand, (vi) silver nanoparticles integrated with dual B/P-doped g-C_3N_4 enhance visible-light absorption and charge separation, boosting hydrogen-generation efficiency for sustainable solar-driven water splitting will be discussed. Overall, the presentation will demonstrate how the integration of materials science, nanotechnology, and renewable-energy engineering can contribute to efficient energy harvesting, thermal and electrochemical storage, hydrogen production, and sustainable energy systems. The presentation will also highlight our initiative to promote Pondicherry University's adoption of solar energy for its energy needs and its vision to achieve net-zero carbon emissions by 2035, thereby promoting sustainable practices at HEIs.

Keywords: *Li-ion battery; materials; nanotechnology; renewable-energy systems; solar energy*

KN03 KEYNOTE ADDRESS · ENERGY SECTOR

Energy Transitions for Environmental Resilience: Integrating Smart Grids for a Net-Zero Future

W. D. A. S. Rodrigo[1*]

[1]*Department of Electrical Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: asankar@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.3

Abstract

Accelerating global climate action and protecting vital ecosystems require a rapid, structural transition toward high-penetration renewable energy systems. However, replacing traditional fossil fuel generation with variable solar and wind power introduces critical grid stability challenges, including supply intermittency, voltage volatility, and transmission congestion, that can hinder deep decarbonization efforts. This research highlights how the strategic integration of smart grid infrastructure, utility-scale Battery Energy Storage Systems (BESS), and digital energy management acts as a direct enabler of environmental sustainability. By replacing carbon-intensive peaking units and preventing clean energy curtailment, smart grid technologies minimize the ecological footprint of power generation while accelerating the pathway to net-zero emissions. From an engineering and environmental perspective, maximizing clean energy hosting capacity relies on robust utility-scale BESS architecture, incorporating advanced Battery Management Systems (BMS), Power Conversion Systems (PCS), and dynamic grid code compliance, to safely decouple power generation from immediate demand. Parallelly, intelligent demand management systems leverage AI-driven Energy Management Systems (EMS), SCADA integration, and automated demand response to optimize load profiles, eliminate energy wastage, and curb operational carbon emissions. Furthermore, implementing multi-layer protection schemes, digital monitoring, and fault-containment frameworks ensures long-term operational safety while safeguarding local ecosystems from energy-related environmental hazards. Drawing on practical engineering frameworks and field deployment models, this presentation outlines a concrete roadmap for professionals, grid operators, and policymakers seeking to build environmentally resilient power networks without compromising system security or operational reliability.

Keywords: *battery energy storage systems (BESS); decarbonization; demand response; energy management systems; grid stability; net-zero emissions; smart grids*

KN04 KEYNOTE ADDRESS · WATER SECTOR

Integrated Multi-Proxy Techniques for Assessing Submarine Groundwater Discharge and Saline Intrusion along the Coastal Tracts of South-Eastern India: Implications for Sustainable Water Resources

K. Srinivasamoorthy[1*], G. Ponnumani[1], A. R. Khanna[1], K. Ramesh[1], V. Gopalakrishnan[1] and D. S. Varshini[1]

[1]*Department of Earth Sciences, School of Physical, Chemical, and Applied Sciences, Pondicherry University, Puducherry, India*

**Corresponding author: moorthy.esc@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.4

Abstract

Coastal aquifers are the most vulnerable freshwater resources, threatened by seawater intrusion (SWI), excessive groundwater withdrawal, anthropogenic, and climate-related influences. Further, submarine groundwater discharge (SGD) is groundwater flow from the land to the sea that has emerged as a significant pathway that links groundwater flow from the land to the sea that transports freshwater, dissolved salts, nutrients, trace elements, and Rare Earth Elements (REEs) and other geochemical constituents to the coastal ocean. Recent investigations in the coastal aquifers of southeast India (Tamil Nadu and Puducherry) have identified seawater intrusion affecting 20 to 40% of groundwater resources, and SGD rates of about 0.01 to 0.98 $m^3\ m^{-2}\ d^{-1}$, which transport chemical constituents to the coastal oceans. Hence, it is imperative to understand the dynamics of SWI and SGD for sustainable water resource management. The present study uses multi-proxies that combine direct and field-based measurements, groundwater flow and transport modeling, resistivity investigations (ERT), hydrochemical indicators, radon, nutrients, trace elements, and REEs to identify groundwater dynamics. Darcy law, water budget, and seepage studies provided direct measurements of groundwater flux, while electrical resistivity imaging techniques delineated freshwater, saline water, and subsurface zones and pathways. Groundwater flow modeling was used to isolate the mechanisms and spatial variations of SWI and SGD under diverse geohydrological scenarios. Ionic ratios were used to isolate fresh, saline and mixed groundwater flows. Hydrochemical and geochemical tracers indicate that SGD acts as both source and sink for dissolved constituents through biogeochemical transformations. Radon-derived SGD estimates indicate substantial groundwater contributions to the coastal zone, while ERT confirms the existence of complex freshwater-saltwater transition zones and recirculated seawater pathways. Nutrients predicted SGD fluxes and were found to be influenced by coastal eutrophication, productivity and biogeochemical cycling. Trace elements and REEs identified processes like water-rock interaction, mixing, and geochemical evolution, thereby altering the chemical composition of coastal groundwater. The integrated approach suggested a strong impact of the spatial and temporal variability of SWI and SGD, which is controlled by factors like hydraulic gradients, recharge, and aquifer heterogeneity. Multi-proxy datasets were compared with global studies and found to be comparable with several tropical and subtropical coastal aquifers. The study also highlights the need to integrate multiple techniques for more accurate and reliable assessment of SWI and SGD. The findings provide critical insights for sustainable coastal aquifer management, climate resilience planning, groundwater protection, and the preservation of sensitive coastal ecosystems under increasing environmental stress.

Keywords: *coastal groundwater; nutrients; radon; rare earth elements; resistivity imaging; saline water intrusion; seepage meters; submarine groundwater discharge; sustainable management; trace elements*

SECTION

02

Invited Lectures

LECTURE SCHEDULE

CODE	TIME	INVITED SPEAKER
DAY 01 · MONDAY, 05 OCTOBER		
IL01 WATER	11:10 – 11:30	**Dr. R.M.M. Pradeep** The SOHAN Nexus: An Equipartition Ruler for Coupled Socio-Technical Systems *General Sir John Kotelawala Defence University, Sri Lanka*
IL02 ENERGY	14:00 – 14:20	**Prof. B.M. Jaffar Ali** Towards Sustainability and Circular Economy in Biofuel Production *Pondicherry University, India*
IL03 ENERGY	14:20 – 14:40	**Prof. D.S. Sharada** Molecular Engineering of Carbon-Based and Organic Functional Materials for Sustainable Energy Applications *Pondicherry University, India*
IL04 WATER	14:40 – 15:00	**Dr. Chamal Perera** Cyclone Ditwah as a System Stress Test: Lessons for Flood Risk Management in Sri Lanka *University of Moratuwa, Sri Lanka*
DAY 02 · TUESDAY, 06 OCTOBER		
IL05 ENERGY	09:00 – 09:20	**Mr. Pradeep Raj Pandey** Bhote Koshi–Rasuwa Disaster in August 2026: Relevance and Takeaways for Countries from the Himalayas to the Sea *UMCDSRC, National College, Kathmandu University, Nepal*
IL06 WATER	09:20 – 09:40	**Ms. Utsaha Pahadi** When Water Becomes a Disaster: Nepal's Floods, Climate Injustice, and the Energy–Water Nexus *SAF-Nepal; National College, Kathmandu University, Nepal*
IL07 WATER	11:50 – 12:10	**Dr. Kasun De Silva** Sand Mining and Bridge Pier Scour in the Kelani River of Sri Lanka: A 2D Modelling Study *University of Moratuwa, Sri Lanka*
IL08 ENERGY	12:10 – 12:30	**Dr. S. Sivasankari** Valorisation of Mass-Cultured Marine Macroalgae Chaetomorpha sp. for Biodiesel Production and Value-Added Products *Pondicherry University, India*
IL09 ENERGY	13:30 – 13:50	**Dr. Krishna Kumar Jaiswal** Transition to the World of Microalgae for the Water–Biomolecule–Biofuel Nexus: Illuminating the Path to Foster a Greener Ecosystem and the SDGs *Pondicherry University, India*
IL10 WATER	15:40 – 16:00	**Dr. E. Yuvaraj** GIS and Multi-Criteria Decision Analysis for Sustainable Development of Coastal Water Bodies Created by 2004 Tsunami and Tectonic Subsidence in Andaman and Nicobar Islands, India *Pondicherry University, India*

IL01 INVITED LECTURE · WATER SECTOR

The SOHAN Nexus: An Equipartition Ruler for Coupled Socio-Technical Systems

R. M. M. Pradeep[1*]

[1]*Center for Disaster Management Research, Faculty of Computing, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*

**Corresponding author: pradeep@kdu.ac.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.5

Abstract

Urban flooding persists despite advanced modelling and GIS, because science integrates weakly into policy and practice. This paper has introduced the Sohan Nexus from the HydroGIS urban flood management research, a utopian equipartition ruler for coupled sociotechnical systems: equilibrium in any system means every linkage holds equal reference weight, with real systems read as deviations. The demonstration ground is municipal land development approval: five stakeholder categories (landowners, municipal authorities, hydrology modellers, GIS modellers, HydroGIS developers) joined by five bidirectional linkages, scientific to scientific (L1), science to tool translation (L2), tool to governance (L3), tool to implementation (L4), governance to implementation (L5). Integration weights were computed by multiattribute utility theory with weighted average programming across 32 cases, validated by multicriteria group decision making with 70 experts. The ruler fixes $W_i = 100/L$, the unique maximum entropy reference, so imbalances must be justified; deviation is $\delta_i = P_i - W_i$. Weights averaged the 20% reference, implying balance, yet compliant Colombo developments attenuated only about 22% of the flood peak after development, against roughly 73% required to approach the discharge before development. The gap traces to L2, 7.6 percentage points below equipartition, robust across four alternative references and 100,000 Monte Carlo draws, grounding the weakest linkage law: capacity is governed by the minimum deviation, not aggregate balance. The Sohan Nexus offers common ground across sociotechnical systems: urban flood management, energy and water governance, reservoir operations, hydropower with grid storage, and climate adaptation, where translation linkages are the binding constraint. It prescribes rebalancing the weakest linkage rather than expanding modelling capability.

Keywords: *energy and water nexus; equipartition ruler; HydroGIS; maximum entropy; Sohan Nexus; urban flood management; weakest linkage law*

IL02 INVITED LECTURE · ENERGY SECTOR

Towards Sustainability and Circular Economy in Biofuel Production

B. M. Jaffar Ali[1*]

[1]*Department of Green Energy Technology, Pondicherry University, Puducherry, India*

**Corresponding author: jaffarali.get@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.6

Abstract

Sustainability and circular economy have become increasingly vital to be met in any successful translational research. Keeping this in mind, a serious of innovative processes have been developed for the volarization of biomass to biofuel. We present series of innovations made in the processes leading to the production bioethanol and biodiesel, with a specific emphasis on the sustainability and circular economy. Adopting a standard microalgae culture for the extraction of carbohydrate from harvested biomass, we have established a cost-optimized cultivation strategies for *Arthrospira maxima* using an alternative culture media based on NPK–soil extract–NaCl. A self-flocculation-based harvesting process to further cut-down production cost effected from the reduction in processing time and minimal chemical use. The harvested biomass subjected to cascaded biorefinery approach for integrating phycocyanin extraction, lipid recovery for biodiesel, and saccharification–fermentation to bioethanol. Techno-economic analysis of product portfolios and process configurations reveal how production cost, power demand and over-all carbon footprint is reduced. Our work demonstrated a financially sustainable model for biofuel extraction process in *Arthrospira maxima*. In another approach, conventional ethanolic fermentation was revisited for cost-reduction wherein sugarcane molasses and *A. maxima* dry biomass jointly function as substrate and nutrient matrix, enabling efficient ethanol production without a separate fermentation media and yielding a more cost-effective first-generation biofuel process. In the process of conversion of oil to biodiesel, a novel patented method of conversion, namely, a one-pot subcritical, catalyst-free and by-product-free transesterification process is developed for total conversion of diverse oils to biodiesel. Salient feature of the process is that by eliminating the use of catalyst, processes associated with its separation were eliminated. Further, the glycerol is also converted into additive products, eliminating the need to separate it. We thus developed a proof-of-concept of technology for total conversion of oil to biodiesel requiring fewer chemicals and processes. Interestingly, there was an in-built process of recovering the excess alcohol from the reaction mixture. We thus demonstrate a sustainable and circular economy approach in the production of biofuels and value-added products by means of utility of discard for subsequent value extraction, complete volarization of biomass, developing a process that inherently employ lesser chemicals as well as avoids generation waste water, uses minimum number of chemicals and reduces process steps significantly.

Keywords: *biodiesel; bioethanol; biorefinery; circular economy; microalgae; transesterification*

IL03 INVITED LECTURE · ENERGY SECTOR

Molecular Engineering of Carbon-Based and Organic Functional Materials for Sustainable Energy Applications

D. S. Sharada[1*]

[1]*Molecular Engineering and Catalysis Laboratory, Department of Green Energy Technology, Madanjeet School of Green Energy Technologies, Pondicherry University, Puducherry, India*

**Corresponding author: drdssharada@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.7

Abstract

The transition toward sustainable energy technologies requires advanced materials for efficient energy conversion, storage, and utilization. Owing to their structural diversity, tunable electronic properties, high surface area, conductivity, and chemical stability, carbon-based materials have emerged as versatile functional materials. Graphene, carbon nanotubes, carbon quantum dots, porous carbons, and graphitic carbon frameworks have been widely investigated for energy harvesting, electrochemical energy storage, catalysis, and environmental remediation. Simultaneously, organic molecular engineering has opened new opportunities for designing next-generation energy materials. The rational design of conjugated organic molecules, donor–acceptor systems, and functional organic architectures enables control over light absorption, charge separation, charge transport, interfacial interactions, and catalytic activity. Hybrid organic materials, including organic semiconductors, covalent organic frameworks (COFs), polymeric networks, and molecule-functionalized carbon materials, have attracted significant interest due to their structural tunability and enhanced charge-transfer properties. The integration of carbon-based materials with organic molecules and hybrid frameworks can generate multifunctional systems with synergistic electronic and structural interactions. These materials show promise in solar energy conversion, hydrogen generation, CO_2 reduction, batteries, supercapacitors, electrocatalysis, and photocatalysis. Their tunable physicochemical properties provide opportunities for developing efficient, cost-effective, and environmentally benign solutions to global energy and environmental challenges. This presentation highlights recent developments in carbon-based materials, organic molecular engineering, and hybrid organic materials, focusing on fundamental principles, emerging applications, and future perspectives for clean, efficient, and sustainable energy technologies.

Keywords: *carbon-based materials; electrocatalysis; energy conversion; energy storage; organic molecular engineering; photocatalysis; sustainable energy*

IL04 INVITED LECTURE · WATER SECTOR

Cyclone Ditwah as a System Stress Test: Lessons for Flood Risk Management in Sri Lanka

C. Perera[1,2*]

[1]*Department of Civil Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*
[2]*UNESCO Madanjeet Singh Centre for South Asia Water Management, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: chamalp@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.8

Abstract

Cyclone Ditwah provided an opportunity to examine how Sri Lanka's flood-risk arrangements performed during a rapidly evolving, high-impact event. Rainfall accumulated over 26–28 November 2025 was equivalent to about 15.8% of the country's average annual rainfall, producing widespread flooding and landslides. This study reviews the event across rainfall, river response, flood warnings, reservoir storage conditions, and community experience. At most evaluated locations, minor-flood warnings provided more than 3 h of advance notice, whereas major-flood warnings at several stations offered very short, zero, or negative lead times. Daily records from 79 major reservoirs across 27 basins also showed marked differences in available storage margins, with some basins entering the critical rainfall period under marginal or negative buffering conditions. These observations demonstrate the importance of linking forecasts with reservoir readiness, warning escalation, coordinated emergency procedures, and community preparedness. Cyclone Ditwah therefore offers lessons for strengthening integrated flood-risk management under future extreme events.

Keywords: *Cyclone Ditwah; early warning; flood risk management; reservoir preparedness; system stress*

DOI: https://doi.org/10.31705/ICEWSE.2026

IL05 INVITED LECTURE · ENERGY SECTOR

Bhote Koshi–Rasuwa Disaster in August 2026: Relevance and Takeaways for Countries from the Himalayas to the Sea

P. R. Pandey[1*]

[1]*UMCDSRC, National College, Kathmandu University, Kathmandu, Nepal*

**Corresponding author: pradeep.pandy219@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.9

Abstract

The world has been facing natural calamities and disasters with increasing frequency in the past decades. Unprecedented floods in Pakistan and Bangladesh, the threat of water level rising to the island countries, increasing excessive damage in India and Nepal and of course, "never before event", the Bhote Koshi–Rasuwa disaster of 26 August 2026. While natural disasters have happened, it can be seen that the primary trigger has been global warming and rising atmospheric temperatures, as well as the ocean. This "mud-debris-boulder tsunami" was a major cascading mountain hazard that caused extensive human, environmental, and economic damage in Nepal. This event is understood to have originated with a high-altitude slope failure and an ice–rock avalanche in the Langtang Lirung area, followed by the rapid mobilization of water, sediment, boulders and debris into the Bhote Koshi–Trishuli river system. The exceptional speed and destructive force of the debris flow provided very limited warning to downstream communities and infrastructure. Nepal experienced substantial loss of life, thousands of people reported missing, widespread displacement, and extensive damage to roads, bridges, hydropower facilities, agricultural land, houses, businesses, and public infrastructure. Preliminary assessments have estimated damage and losses of over 1500 confirmed dead, over 5000 missing, as well as approximately NPR 408 billion in destroyed infrastructure, private housing, and agricultural land, with reconstruction and recovery requirements estimated at more than NPR 723 billion. The event also exposed the vulnerability of Nepal's mountain settlements and strategically important infrastructure to cascading hazards. The presentation examines the possible geological and hydrological causes, the movement and speed of the debris flow, the human and economic consequences, and the challenges faced by search-and-rescue teams from both Nepal and abroad. Finally, the presentation proposes a phased rehabilitation strategy based on the principle of "Build Back Safer." Key priorities include restoring livelihoods and essential infrastructure, improving early-warning systems, strengthening hazard mapping, and relocating settlements from high-risk areas. It also emphasizes the need for regional countries to work together in developing early warning systems, cooperation in working together post-disaster, in supporting data and technology sharing, access to funds for studying and preparing for such events, and most of all in working together to demand financial compensation for the damage caused by such "human-triggered" natural disasters which aren't of the region's making.

Keywords: *build back safer; cascading mountain hazards; climate justice; debris flow; early warning systems; Nepal*

IL06 INVITED LECTURE · WATER SECTOR

When Water Becomes a Disaster: Nepal's Floods, Climate Injustice, and the Energy–Water Nexus

U. Pahadi[1,2*]

[1]*National College (Kathmandu University), Kathmandu, Nepal*
[2]*SAF Nepal, Kathmandu, Nepal*
**Corresponding author: 2026utsaha@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.10

Abstract

On 26 August 2026, an ice-and-rock avalanche near Langtang Lirung on the Nepal–China border triggered a glacial lake outburst flood down the Bhote Koshi–Trishuli river system, killing 1,287 people, leaving 5,083 missing, and disconnecting an estimated 430–1,000 MW of hydropower capacity, including the Rasuwagadhi, Chilime, and Upper Trishuli-1 plants, at an estimated cost of USD 2.56–5 billion. This study examines the disaster as a case of cascading water–energy risk and climate injustice, given Nepal's contribution of roughly 0.027% of global greenhouse gas emissions. Using a case-study method, secondary data from Nepal's National Disaster Risk Reduction and Management Authority, the Nepal Electricity Authority, and international reporting (Reuters, AP, Kathmandu Post) were cross-checked against comparative emissions and vulnerability datasets (ND-GAIN Index, Climate Watch, Our World in Data), and triangulated with policy analysis of regional frameworks, namely ICIMOD's glacial-lake monitoring programme and SAARC/BIMSTEC disaster-cooperation mechanisms, to identify implementation gaps. Findings show that Nepal's hydropower-dependent energy strategy remains acutely exposed to accelerating glacial retreat, with 47 glacial lakes jointly classified by ICIMOD and Nepal's government as potentially dangerous, revealing a structural mismatch between energy planning and climate risk. The study concludes that climate-resilient siting and design standards, glacial-lake monitoring, and regional early-warning cooperation among Nepal, India, and China must be treated as preconditions, rather than co-benefits, of hydropower-led energy transitions, and that adaptation finance must expand at the pace of accelerating disaster risk across the wider Himalayan region.

Keywords: *climate injustice; energy–water nexus; glacial lake outburst floods (GLOF); hydropower resilience; Nepal; South Asia climate finance*

IL07 INVITED LECTURE · WATER SECTOR

Sand Mining and Bridge Pier Scour in the Kelani River of Sri Lanka: A 2D Modelling Study

A. W. Thembiliyagoda[1], P. K. C. De Silva[1*] and T. M. N. Wijayaratna[1]

[1]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: kasunds@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.11

Abstract

Sand mining in rivers, driven by the construction industry, threatens nearby bridges by intensifying pier scour. This study quantifies the effect of mining pits on scour at the Kelanisiri Bridge over the Kelani River, Sri Lanka, using HEC-RAS 2D. A coupled hydrodynamic and sediment transport model was built from survey and LiDAR terrain, observed flow and tidal boundaries, and the Van Rijn method, and run for 2003 to 2016. The hydraulic model was calibrated against observed water levels ($R^2 = 0.94$, NSE = 0.91), and the coupled model reproduced observed bed elevations ($R^2 = 0.91$, NSE = 0.88). Mining pits were then embedded in the terrain at 500 m and 1200 m upstream and downstream of the bridge, with varying depth, footprint, shape and lateral position. Baseline scour depths were 4.85 m and 5.26 m at the two piers. A pit close to the bridge on the upstream side increased scour by about 20%, compared with 16% for a nearby downstream pit and 8% for a distant upstream pit. Rectangular pits caused the greatest scour, followed by elongated and circular pits, and deeper, larger pits worsened it. Pits within 5 m of the riverbanks caused bank erosion and further increased scour. The results support the existing buffer zones and show that lateral pit position should also be regulated. Further, the validated model offers a transferable decision-support tool for managing sand mining near bridges.

Keywords: *HEC-RAS; hydro-morpho dynamics; mining pits; riverbed erosion; sediment transport*

IL08 INVITED LECTURE · ENERGY SECTOR

Valorisation of Mass-Cultured Marine Macroalgae *Chaetomorpha sp.* for Biodiesel Production and Value-Added Products

L. M. Tom[1], K. M. Aslam[1], P. G. Suriya[1] and S. Sivasankari[1*]

[1]*Microbial and Bioprospecting Bioenergy Laboratory, Department of Green Energy Technology, Madanjeet School of Green Energy Technologies, Pondicherry University, Puducherry, India*

**Corresponding author: sivasankari.get@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.12

Abstract

Biodiesel production from third-generation biomass has seized worldwide attention because it effectively solves future energy constraints and thereby reduces the 'food versus fuel' debate. The present work aims to develop an exploratory approach to the mass cultivation of Chaetomorpha sp. a marine macroalgae collected from east-coast of Pondicherry, India for biodiesel production with higher cost-effectiveness. Macroalgae, a photosynthetic autotrophic organism, is rich in lipids, proteins and carbohydrates. This versatile organism has the ability to reduce greenhouse gases and climatic changes. The valorization of Chaetomorpha sp. biomass by sequential acid-base hydrolysis combined with two-phase solvent extraction under optimized conditions obtained a higher bio-oil yield of 83.7% (DW) and a lower yield of 29.6% (DW), which ascertains fatty acid concentration at varying meteorological conditions. The overall status of biodiesel production from macroalgae biomass shows inadequacy in coping with the global demand due to the lack of large-scale production. The current work emphasizes the vast potential of macroalgae and its conversion rate into biodiesel and value-added products. Strategic cultivation methods have been tried for the mass culture at laboratory level with low-cost mineral supplements.

Keywords: *biodiesel; bio-oil; Chaetomorpha sp.; macroalgae; transesterification*

IL09 INVITED LECTURE · ENERGY SECTOR

Transition to the World of Microalgae for the Water–Biomolecule–Biofuel Nexus: Illuminating the Path to Foster a Greener Ecosystem and the SDGs

K. K. Jaiswal[1*]

[1]*Bioprocess Engineering Laboratory, Department of Green Energy Technology, Pondicherry University, Puducherry, India*

**Corresponding author: kkjindia.get@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.13

Abstract

The transition toward the world of microalgae has fascinated researchers seeking to achieve sustainability, fostering a greener ecosystem and a better life on Earth. Microalgae (ubiquitous microorganisms that thrive in diverse environments) have been employed to test a biorefining platform for mitigating wastewater and producing energy, food, nutraceuticals, medicines, and a variety of high-value organic molecules. However, the potential frontrunner in this water-biomolecule-biofuel nexus race—high operational costs, energy requirements, and limited biomass supply—suffers from considerable neglect. Microalgae research investigates the impact of green technologies, an emerging nature-based technology that offers wastewater remediation and the production of biomolecules/metabolites in microalgal biorefineries, in relation to the UN SDGs. Two novel microalgae, *Chlorosarcinopsis bastropiensis* and *Polyedriopsis spinulosa*, exposed to Pb(II) and Cd(II) pollutants have exhibited varied responses in Cell viability and IC50 values (397.75 mg/L for *C. bastropiensis* and 490.16 mg/L for *P. spinulosa*), indicating higher tolerance to Pb(II) in both microalgae, and subsequent effects on biofuel integrity. Also, the synergistic potential of the novel oleaginous microalga *Chlorella sorokiniana* for phyco-mitigation of raw urban wastewater dominated in the HRAP, with a ~90% increase in dissolved oxygen, high biomass (1.13 g/L), and increased lipid content (~31%). Moreover, graphitic biochar (crystalline phase 2H indexing plane) and bio-oil ($23.73 \pm 0.6\%$) synthesis via hydrothermal carbonization-co-liquefaction of Chlorella sorokiniana biomass and remediation of multiple heavy-metal systems, viz. Cu(II), Ni(II), Co(III), and Cd(II) have been explored for the development of more affordable biorefineries. Furthermore, nanomaterial catalysts (e.g., MOFs) have emerged as a recent trend for the simultaneous transesterification of both FFA & TGA of microalgal lipids to produce renewable biodiesel. Also, microalgal biomass can be converted into various biofuels (biomethane, bioethanol, biodiesel, or biohydrogen) as well as a range of high-value products and bioactive molecules (such as PUFA, β-1,3-glucan, astaxanthin, lutein, phycobiliprotein, β-carotene, and chlorophyll) for various real-world products. Therefore, microalgal technology directly addresses several of the United Nations SDGs, including Goal 6 (Clean Water) and Goal 7 (Affordable Energy).

Keywords: *bio-active molecules; microalgae biorefinery; real-worth products; renewable biofuels; SDGs*

IL10 INVITED LECTURE · WATER SECTOR

GIS and Multi-Criteria Decision Analysis for Sustainable Development of Coastal Water Bodies Created by 2004 Tsunami and Tectonic Subsidence in Andaman and Nicobar Islands, India

E. Yuvaraj[1*], R. Kirubashankar[2], S. Rassel[1], S. Gokul[1], A. R. Adharsh[1] and A. Saravanan[3]

[1]*Department of Coastal Disaster Management, Pondicherry University, Sri Vijaya Puram, India*
[2]*Fisheries Division, ICAR-Central Island Agricultural Research Institute, Sri Vijaya Puram, India*
[3]*Department of Geography, Mahatma Gandhi Government College, Mayabunder, India*
**Corresponding author: yuvarajdm@pondiuni.ac.in*
DOI: https://doi.org/10.31705/ICEWSE.2026.14

Abstract

More than two decades after 2004 Tsunami and Tectonic subsidence in Andaman and Nicobar Islands, the resultant generated coastal water bodies are remain unutilized in many locations and some of the areas are recently land filled for the construction. These seawater inundated areas are highly vulnerable to natural disasters and crocodile infestation, utilising these lands for settlements and commercial constructions is not recommended. The present study aims to identify site suitability for sustainable development of inundated areas through Nature-based Solutions and Multi-Criteria Decision Analysis. The Geographic Information System (GIS) techniques, along with Multi-Criteria Decision Analysis (MCDA) and the Analytical Hierarchy Process (AHP), are used for the site suitability analysis of Brackish water Aquaculture, particularly shrimp culture and crab culture, which is clearly aligned with local livelihood preferences. In this study, three inundated areas of South Andaman Island are selected for detailed analysis: Ograbrach, Wandoor, and Stewart Gunj. A total of 13 criteria were used, which are categorised into environmental parameters, water quality, and infrastructure. The spatial interpolation maps are prepared for all 13 criteria. The AHP is employed to weight and rank the criteria. Using weighted overlay analysis, suitable areas for aquaculture activities are identified. The result shows that 9.6 ha in Ograbrach and 36.5 ha in Stewart Gunj are most suitable for Shrimp culture, and 18.5 ha in Wandoor is suitable for crab culture. The findings highlight the importance of introducing resilient development strategies in the inundated areas to ensure their long-term viability and sustainability.

Keywords: *brackish water aquaculture; GIS; multi-criteria decision analysis; seawater inundation; sustainable development*

SL01 SPECIAL LECTURE · WATER & ENERGY SECTORS

Planet Green Force: From Green Education to a Living Laboratory for Water, Energy and Climate Action

H. Wickrema[1*]

[1]*Planet Green Force, St. John, U.S. Virgin Islands, USA*

**Corresponding author: harith@planetgreenforce.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.15

Abstract

Planet Green Force (PGF) responds to the urgent need to translate climate and sustainability education into practical action by empowering schoolchildren to become informed environmental leaders, producers, innovators, and advocates. Developed in collaboration with UNESCO principles, PGF integrates climate science literacy, the Sustainable Development Goals, and the Green Academies pillars of water security, waste management, clean energy, and biomass production through experiential learning, research, community engagement, and school-based projects. Ananda College, Colombo, became the first PGF chapter and has served as the principal demonstration site. Activities have included teacher-training and Train-the-Trainer programmes, the International Day of Greening Education, student-led sustainability competitions and idea campaigns, field-based biodiversity learning, food-security initiatives such as the Seeds of Security programme and Chaya cultivation, and hands-on learning in soil regeneration, composting, aquaponics, hydroponics, nutrition, and sustainable agriculture. The emerging Planet Green Force Center at Ananda College is designed as a living learning and research laboratory where students can explore resource efficiency, food and water security, clean energy, circular practices, and emerging technologies including artificial intelligence for sustainable production. Experience at Ananda demonstrates how a school can become a platform for climate action by linking classroom learning with measurable environmental practice, teacher leadership, student ownership, and community outreach. The PGF model offers a scalable framework for developing environmentally responsible youth and strengthening water-energy-food-climate literacy across schools in Sri Lanka and beyond.

Keywords: *clean energy; climate science literacy; food security; greening education; water security; youth engagement*

SECTION

03

Oral Presentations: Water Track

Contributed research on water resources, hydrology, climate resilience and water governance, presented in the Water sector sessions.

THEMES

- Aquifer Recharge & Floodplain Management
- Climate Resilience & Water Security
- Coastal & Marine Water Systems
- Geo-Hydroinformatics & Decision Support Systems
- Groundwater Modelling & Disaster Resilience
- Groundwater Vulnerability & Climate Risk Reduction
- Hydrogeochemical Pathways for Sustainable Infrastructure
- Irrigation & Agricultural Water Management
- Nature-Based Water Solutions
- Remote Sensing, GIS & AI for Water
- Surface Water Hydrology & Basin Management
- Urban Water & Resilient Infrastructure
- Water Governance & Socio-Hydrology

WAT-54 ORAL PRESENTATION · WATER TRACK · AQUIFER RECHARGE & FLOODPLAIN MANAGEMENT

Separating Recharge Receptivity from Flood-Water Availability for Managed Aquifer Recharge in Wadi Qanunah, Saudi Arabia: A Physically Informed Framework Corroborated by an Operational Well Network

I. M. Gaber[1*], A. Alghazi[2] and A. M. E. Kenawy[3,4,5]

[1]*Advanced Telecommunications Solutions & Services (ATSS) Company, Riyadh, Saudi Arabia*
[2]*Water Information Center, Ministry of Environment, Water and Agriculture, Riyadh, Saudi Arabia*
[3]*Instituto Pirenaico de Ecología, Consejo Superior de Investigaciones Científicas (IPE-CSIC), Zaragoza, Spain*
[4]*Laboratorio de Climatología y Servicios Climáticos (LCSC), CSIC-University of Zaragoza, Zaragoza, Spain*
[5]*Department of Geography, Mansoura University, Mansoura, Egypt*
**Corresponding author: islammohamed1606@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.16

Abstract

Managed aquifer recharge (MAR) can convert episodic floodwater into strategic groundwater storage in arid wadis, but conventional suitability mapping often conflates subsurface recharge receptivity with access to deliverable water. We developed a physically informed, non-compensatory framework for Wadi Qanunah, southwestern Saudi Arabia. Recharge receptivity was derived from AHP-weighted lithology, slope, sand fraction, and distance to drainage, with bounded penalties for electrical conductivity and root depth. Flood-water availability was estimated independently from rainfall-weighted D8 flow accumulation and distance-decayed accessibility to qualifying channels using GPM IMERG V07 and CHIRPS v3 RNL rainfall (2003–2024). The components were integrated by geometric mean, an availability veto, and land-surface constraints. Flood-water availability is therefore a relative routed-water accessibility metric rather than simulated runoff discharge or event-specific flood yield. Replacing IMERG with CHIRPS changed basin-scale routed volume by about 22% but produced nearly identical MAR rankings (Spearman ρ = 0.9986). Seven hydraulically distinct candidate sites remained persistent across 119 structural and AHP-weight perturbation scenarios, with diversion distance as the dominant structural uncertainty. Post-selection spatial corroboration using 56 operational production wells showed strong concentration within high-priority MAR zones; these wells provide operational hydrogeological context rather than independent field validation. The framework provides a robust screening basis for prioritising MAR field investigations by explicitly separating recharge receptivity, routed flood-water accessibility, and operational groundwater context, while site-scale infiltration and hydraulic testing remain necessary before implementation.

Keywords: *flood-water availability; geospatial modelling; managed aquifer recharge (MAR); operational well network; recharge receptivity; Wadi Quannah*

WAT-06 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Sea Level Rise and Household Vulnerability: Evidence from Coastal Bangladesh

R. Biswas[1*]

[1]*Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh*

**Corresponding author: riyabiswas3213@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.17

Abstract

Bangladesh's coastline faces sea-level-rise-related shocks, yet evidence on how coastal exposure shapes household economic and water security remains limited. Using the 2022 Household Income and Expenditure Survey, this study constructs a composite Economic Vulnerability Index (EVI) drawing on the IPCC framework: exposure (climate-related shocks), sensitivity (dependency ratio), and adaptive capacity (expenditure, bank account ownership, durable assets, and access to safe water and sanitation), equally weighted on a 0–1 scale. Using the official WARPO (2003) coastal-zone delineation, mean EVI is significantly higher in the 48 upazilas directly exposed to the sea or estuaries than in the 99 interior-coast upazilas (diff = 0.006, p = 0.007, n = 3,806). Pooling Chattogram, Khulna, and Barisal divisions, coastal districts are significantly more vulnerable than non-coastal districts (diff = 0.008, $p < 0.001$, n = 5,293); propensity score matching confirms this (ATT = 0.008, $p < 0.001$). Within the 14 BBS coastal districts (n = 2,713, EVI range 0.09–0.63, mean 0.26), education is negatively associated with vulnerability and household size positively associated (both $p < 0.001$; R-squared = 0.047). Matching shock-exposed and non-exposed households on the non-exposure components of EVI shows no significant difference (ATT = –0.006, p = 0.41), indicating vulnerability differences are geographic rather than driven by a single year's shocks. These findings support a spatial, exposure-graded view of coastal vulnerability, with implications for water infrastructure and disaster preparedness.

Keywords: *coastal Bangladesh; economic vulnerability; propensity score matching; sea level rise; water security*

WAT-32 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Climate Change–Hydropower Reliability Framework: Linking Climate, River Flow and Energy Security in the Punatsangchu and Wangchu River Basins, Bhutan

C. Zam[1*]

[1]*Gyalsung Infra, Thimphu, Bhutan*

**Corresponding author: chokizam1994@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.18

Abstract

Bhutan's hydropower sector is an important contributor to the country's energy supply and economy. However, climate change is expected to alter temperature, rainfall patterns, and river flows, potentially affecting seasonal water availability and hydropower reliability. This study synthesizes existing evidence to develop a simple climate–hydropower reliability framework for Bhutan. Observed climate evidence from the Climate Atlas of Bhutan (1996–2025), projected climate and river-flow findings from the CMIP6 assessment, documented extreme-weather impacts, and hydropower-related concepts from the Power System Master Plan 2040 are reviewed and compared for the Punatshangchu River Basin (PRB) and Wangchu River Basin (WRB). The assessment indicates contrasting basin responses. The PRB shows increasing flows across the near-, mid-, and long-term periods, with stronger monsoon peaks and increasing risks of flooding, sediment transport, and infrastructure stress. In contrast, the WRB shows declining or stagnant flows in the near- and mid-term periods, raising concerns over dry-season water availability. These findings demonstrate the importance of basin-level climate-risk assessment. The study concludes that hydropower reliability depends not only on annual water availability but also on the timing, variability, and extremes of river flow. The proposed framework links observed and projected climate conditions, hydrology, extreme events, seasonal water availability, and hydropower reliability to support basin-specific and climate-informed hydropower planning in Bhutan.

Keywords: *Bhutan; climate change; CMIP6; energy security; hydropower; river flow*

WAT-46 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Spatio-Temporal Dynamics in Climatic Moisture Balance across Sub-Saharan Africa under the High-Emission SSP5-8.5 Scenario

G. Fernando[1*] and M. Leh[1]

[1]*International Water Management Institute (IWMI), Colombo, Sri Lanka*

**Corresponding author: g.fernando@cgiar.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.19

Abstract

Sub-Saharan Africa faces escalating water stress under accelerating climate change, yet spatially resolved assessments of future moisture availability remain limited. To assess how evaporative demand and precipitation changes may alter moisture regimes under high-emission climate scenarios (SSP5-8.5), this study investigates the spatiotemporal evolution of Climatic Moisture Balance (CMB) defined as the difference between precipitation and potential evapotranspiration (P − PET), across the Sub-Saharan African continent. A six-model ensemble mean, derived from CMIP6 projections at high spatial resolution was employed to quantify regional-scale moisture trajectories for Mid-Century (2036–2065) and End-Century (2071–2100) relative to the historical baseline (1980–2014). Results reveal a strong spatial heterogeneity of climatic moisture balance under SSP5-8.5, with pronounced declines concentrated in Southern and Western Africa. By end-century, Southern Africa is expected to experience the most severe regional moisture deficit, declining from −816 to −1,005 mm/yr (−189 mm/yr), while Western Africa decreases from −497 to −637 mm/yr (−141 mm/yr). Eastern Africa remains comparatively stable, with CMB improving slightly from −585 to −554 mm/yr. In contrast, Middle Africa retains a positive regional moisture balance, increasing from +37 to +73 mm/yr, despite substantial country-level variability. National-scale results identify Mauritania, Chad, Niger, Mali, and Botswana as the most severe structural moisture-deficit hotspots by end-century, whereas parts of Central and coastal West Africa retain localized moisture surpluses. While SSP5-8.5 provides upper-bound risk benchmark, evaluating intermediate emission pathways remains priority for future research. These findings provide macroscopic baselines for transboundary water governance, agricultural climate resilience, and adaptation planning across Sub-Saharan Africa.

Keywords: *climatic moisture balance; CMIP6 ensemble; SSP5-8.5; Sub-Saharan Africa*

WAT-57 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

The Water-Energy Nexus as a Determinant of Resilience for Future Generations: A Comparative Legal Analysis of Southern Africa and South Asia

P. P. Maweto[1*]

[1]*Ismail Mahomed Centre for Human and Peoples' Rights, Faculty of Management, Commerce and Law, University of Venda, Thohoyandou, South Africa*

**Corresponding author: patrickmaweto@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.20

Abstract

Water and energy are planned as separate sectors, yet in climate-stressed regions, they are interdependent, and the failure of either propagates through the other, and every dam, coal plant or aquifer decision allocates resilience between present and future generations who cannot participate in it. This article examines the water-energy nexus as a determinant of intergenerational resilience in the Global South through a comparative doctrinal analysis of Southern Africa and South Asia. Methodologically, legal and policy differences are evaluated against a common four-part matrix: constitutional recognition of environmental rights held for future generations; transboundary basin instruments; standing and justiciability; and the treatment of water-energy interdependence in national climate instruments. The primary materials retrieved for analysis from official gazettes and the world database, are the Constitutions of South Africa, Zimbabwe, Madagascar, the Democratic Republic of Congo, Tanzania, India, Nepal, Pakistan and Sri Lanka; the African Charter and Commission Guidelines on the Right to Water; the SADC Revised Protocol on Shared Watercourses; the Indus Waters and Ganges Waters Treaties; the South African Climate Change, National Water and National Environmental Management Acts; the Zimbabwean Environmental Management Act; the Nationally Determined Contributions of all nine states; and the leading Lahore High Court and Indian Supreme Court climate judgments. Both regions exhibit the same structural exposure but divergent legal capacity. Southern Africa has intergenerational constitutional rights and a basin protocol, but lacks a functioning regional court, while South Asia has advanced climate jurisprudence but lacks a regional water instrument. The article significantly underscores that resilience for future generations requires both, and intergenerational equity should become an express authorisation criterion for water and energy infrastructure.

Keywords: *climate resilience; comparative environmental law; future generations; intergenerational equity; transboundary water governance; water-energy nexus*

WAT-84 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Implementation of a Pilot Climate Information Sharing and Early Warning Dissemination System in Matara District, Sri Lanka

S. Dissanayaka[1*], N. Eriyagama[1], L. Muthuwatte[1], D. Sithara[1], H. Jayasekara[1] and N. Alahakoon[1]

[1]*International Water Management Institute (IWMI), Colombo, Sri Lanka*

**Corresponding author: s.dissanayaka@cgiar.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.21

Abstract

Fragmented information sharing and manual warning dissemination can delay coordinated disaster response in Sri Lanka. This study developed and piloted ENDEARS, a climate information sharing and early warning dissemination platform, in Matara District. The approach combined a review of disaster management policies and warning procedures, stakeholder consultations, and analysis of DesInventar records for 1963–2023 to identify the most vulnerable Divisional Secretariat Divisions (DSds) for testing. The analysis identified highest flood vulnerability in Akuressa, Kamburupitiya, Athuraliya, Thihagoda, and Malimbada; highest landslide vulnerability in Kotapola and Pitabeddara; and strong-wind exposure affecting fishing communities in Weligama. The platform was tested in these highly vulnerable DSDs. ShareNet integrated inter-agency spatial data sharing and geographic information system (GIS)-based hazard–exposure analysis, while AlertNet supported geographically targeted warnings through SMS, dashboards, and email, complemented by local communication channels. Shared visualisation allowed agencies to combine spatial datasets while retaining control over raw-data access. Scenario outputs summarised building exposure at Grama Niladhari division level, supporting the identification of priority settlements. The pilot linked landslide-risk mapping with household contact registration, enabling warnings to target identified at-risk households. Key lessons included maintaining verified household contact databases, formalising inter-agency data sharing, and strengthening automated monitoring and staff capacity. Combining digital alerts with community communication channels was identified as important for inclusive dissemination. The platform demonstrates a practical workflow connecting spatial risk assessment, institutional coordination, and warning communication. These findings provide a basis for adapting the approach to other hazard-prone districts within existing disaster management arrangements.

Keywords: *climate information sharing; disaster preparedness; early warning; GIS; Matara; multi-hazard risk*

WAT-91 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Identification of Emerging Extreme Rainfall and Drought Events in Sri Lanka Using High-Resolution Downscaled Climate Projections and Precipitation Indices (1985–2100)

D. S. E. Gamage[1*], H. Jayasekara[1], N. Eriyagama[1], S. Dissanayake[1], L. Muthuwatta[1] and K. Bergaoui[1]

[1]*International Water Management Institute (IWMI), Battaramulla, Sri Lanka*

**Corresponding author: d.sithara@cgiar.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.22

Abstract

Sri Lanka is highly vulnerable to climate change due to its complex topography, monsoon driven climate system, and strong dependence on climate sensitive sectors. The coarse resolution of global climate models (GCMs) limits their ability to represent the fine scale climatic processes and localized extreme events. To address this gap, a long term (1985-2100) high resolution (15 km) dynamically downscaled climate projections were collaboratively developed by the International Water Management Institute and the Department of Meteorology. The WRF-ARW regional climate model was driven by the bias corrected CMIP6 MPI-ESM1-2-HR GCM under SSP2-4.5 and SSP5-8.5, and validated with ERA 5. The model was selected as the best performing model among 37 tested models. The Simple Daily Intensity Index (SDII), which measures average rainfall intensity, and Maximum Consecutive Dry Days (MCDD), which captures the length of dry spells were estimated to identify future extreme weather events. Projected future indices (2015–2100) were compared with those of the baseline period (1985–2014) to identify emerging localized extremes. An increase in MCDD with a decrease in SDII signals extreme dry conditions. Conversely, a simultaneous increase in both indices indicates the possibility of longer dry spells interrupted by intense downpours. The results reveal distinct regional patterns across Sri Lanka: Jaffna is likely to experience extreme dry conditions whereas Kurunegala is likely to see high intensity rainfall events. This divergence illustrates a broader national trend of spatial microclimatic variation, exposing different regions to varying levels of climate risk. This analysis provides actionable insights to enable long-term preparedness in Sri Lanka's most climate-vulnerable areas.

Keywords: *climate indices; dynamical downscaling; extreme weather events; MCDD; SDII*

WAT-93 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Water Security, Citizenship and Urban Ecology of Bangalore

T. D. Jessly[1*] and H. Basarat[1]

[1]*Faculty of Engineering and Technology, JAIN University, Kanakapura, Bangalore, India*

**Corresponding author: jesslytd@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.23

Abstract

In recent years, Bangalore's urban ecology has been reshaped in ways that have increasingly made water security central to the experiences of social inclusion. For people living in peripheral areas, access to piped water becomes a 'material' to invoke their claim to citizenship and social inclusion. This research highlights a significant gap by understanding water security from a perspective that moves well beyond the popular lenses of climate change and political governance. The study explores the water citizenship nexus through the changing urban ecology and spatial restructuring of Bangalore. The study adopts an ethnographic approach, with frequent visits to some prominent gated communities such as Electronics City, Banashankari, and JP Nagar, as well as slum areas such as Devarajeevanahalli, Vinayaka Layout, and KR Puram to gather ethnographic details. In ethnographic encounters, in contrast to the gated communities, it was observed that in slum areas, the residents predominantly depend on borewells. However, the drying up of borewells pushed them to private water suppliers. Significantly, the water prices are so exorbitant that these slum dwellers are forced to use untreated or contaminated water. Further, it was found that water used in the gated communities was treated partially and sent to these slum areas for their basic survival. Water being a public good should be made available to all the citizens irrespective of their geography, cultural, and spatial dispositions. In this context, access to clean drinking water is not simply reflected in a collection of vignettes of lived experiences; rather, it constitutes a site through which the meanings of citizenship and social exclusion are contested and renegotiated in these marginalized areas.

Keywords: *citizenship; gated communities; social inequalities; spatial restructuring; urban ecology; water security*

DOI: https://doi.org/10.31705/ICEWSE.2026

WAT-94 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Post-Flood Plankton Assemblage Structure as a Bio Indicator Tool for Reservoir Health Assessment: A Case Study from Mahawilachchiya Tank, Dry Zone, Sri Lanka after Ditwah

S. K. K. A. Perera[1*], S. A. M. A. I. K. Senanayake[1]

[1]*Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka, 10250.*

**Corresponding author: kamilakalanka1996@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.24

Abstract

This study assesses plankton dynamics in Mahawilachchiya Tank, Anuradhapura district, Sri Lanka, two months after Cyclone Ditwah, a major flood causing near-complete hydrological flushing. To evaluate post-disaster reservoir health using plankton, representative random plankton samples were collected on Mahawilachchiya Tank in January 2026. Plankton were identified using a trinocular microscope and analyzed using descriptive statistics and relative abundance calculations. Results identified 17 taxa, comprising 54.1% phytoplankton and 45.9% zooplankton. Chlorophyta dominated the phytoplankton, led by highly abundant *Pediastrum* spp. Cyanobacteria contributed 21.2%, indicating persistent nutrient enrichment despite floodwater dilution. Rotifera dominated zooplankton, characterized by eutrophication-tolerant *Brachionus* sp. and *Keratella* sp. The co-dominance of rotifers and cyanobacteria suggests the reservoir retains a mesotrophic character post-flushing, likely sustained by catchment nutrient loading and sediment resuspension. The scarcity of Cladocera and Bacillariophyta reflects ongoing community reassembly, which could suppress food web energy transfer and delay local fish stock recovery. These findings highlight the utility of plankton bioindicators for tracking ecological recovery. Integrating routine plankton monitoring into post-disaster management is recommended to anticipate water quality shifts and safeguard aquaculture livelihoods.

Keywords: *aquaculture; dry zone tank; eutrophication; extreme rainfall; plankton bioindicators*

WAT-95 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Projected Changes in Global Holdridge Life Zones under Climate Change

M. W. W. P. Senarathna[1*], G. M. C. A. Perera[1,2], T. A. J. G. Sirisena[3] and R. L. H. L. Rajapakse[1,2]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa, Sri Lanka*

[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

[3]*Climate Service Center Germany (GERICS), Hamburg, Germany*

**Corresponding author: wenusha55wimukthi@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.25

Abstract

Climate change is altering temperature and the balance between precipitation and atmospheric water demand, with implications for ecosystems and water resources. This study assessed projected global shifts in Holdridge Life Zones as indicators of changing thermal and moisture conditions for 2031–2060 and 2061–2090 under SSP2-4.5 and SSP5-8.5. Median changes in temperature, precipitation, Penman-Monteith potential evapotranspiration and annual frost days from five CMIP6 models were applied to a 1991–2020 observation-based baseline. These models constitute the ISIMIP3b core ensemble, selected for structural independence and to span the CMIP6 climate sensitivity range, so the median summarises a deliberately spread sample. Future classifications used consistent climatic and elevation-based rules at 0.0417° resolution and were compared across a common classified land area. Relative to the baseline, the proportion of classified land changing broad (Level 1) life-zone class rose from 15.06% to 20.76% under SSP2-4.5 and from 18.71% to 31.80% under SSP5-8.5 between the two future periods. Shifts towards warmer climatic regions dominated, particularly across boreal Eurasia and North America. Under stronger forcing, tropical dry forest, shrubland and desert climatic envelopes expanded. Moisture-related changes varied regionally, with wetter transitions in parts of the Sahel and drier transitions in parts of Amazonia. These patterns show why temperature, precipitation and atmospheric water demand must be assessed together when projecting ecological pressure. The findings provide a screening basis for prioritising hydroclimatic monitoring and regional water-balance assessments supporting water resource planning. The projected shifts describe climatic exposure rather than direct estimates of water availability or vegetation replacement.

Keywords: *atmospheric water demand; climate adaptation; climate change scenarios; CMIP6; Holdridge life zones*

WAT-103 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

When Safe Relocation Becomes Long-Term Vulnerability: A 20-Year Assessment of Post-Tsunami Housing Resilience in Seruthur, Nagapattinam, Tamil Nadu

A. Aravinth[1*], P. Sudhakaran[1] and D. Jayakrishnan[1]
[1]*Amrita Vishwa Vidyapeetham, Coimbatore, India*
**Corresponding author: a_aravinth@cb.amrita.edu*
DOI: https://doi.org/10.31705/ICEWSE.2026.26

Abstract

The 2004 Indian Ocean tsunami caused extensive loss of life, housing and livelihoods along the Nagapattinam coast of Tamil Nadu, followed by large-scale relocation and reconstruction of permanent housing. While these interventions addressed immediate disaster risk, the long-term resilience of reconstructed settlements under recurrent water-related hazards remains less examined. Seruthur provides an important case for assessing how post-tsunami housing has responded to subsequent cyclones, heavy rainfall and recurrent flooding. This study will evaluate the water-related resilience and state of housing over the long term since the time of reconstruction in Seruthur, almost two decades after reconstruction. In total, 120 houses underwent a field assessment, comprising 105 post-tsunami houses as well as remaining vernacular houses. Buildings were assessed using visual evaluation of their roofs, walls, floors, plinths, as well as doors and windows with special focus on flooding, water penetration, and water-related deterioration. It was noted that 80 of 105 post-tsunami houses were flooded during rainy and cyclonic weather conditions. Water could penetrate buildings through openings while leaks in the roof further added to moisture exposure. Deterioration observed comprised of rising dampness, efflorescence, mold and algae growth, as well as plaster deterioration and concrete spalling, especially in areas experiencing prolonged water accumulation. These results show that housing resilience post-disaster is not only limited to protection against the hazard itself (tsunami). Flooding caused by rain and cyclones occurring repeatedly and causing increased moisture exposure can have progressive effect on building elements, their condition, and maintenance needs.

Keywords: *climate resilience; coastal environmental exposure; post-tsunami housing; recurrent flooding; water-related building deterioration*

WAT-118 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Identification of Water Security Solutions through Knowledge Exchange and Citizen Science

S. P. Renganayaki[1*], D. Sridhar[2] and M. Thabrez[3]

[1]*School of Civil Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, 632014, India*
[2]*School of Architecture, VIT Bhopal University, Kotri Kalan, Ashta, Sehore District, Bhopal, Madhya Pradesh, 466114, India*
[3]*Research Associate, National Institute of Rural Development and Panchyat Raj, Hyderabad, Telangana, 500030, India*
**Corresponding author: parimala.renganayaki@vit.ac.in*
DOI: https://doi.org/10.31705/ICEWSE.2026.27

Abstract

In developing countries, particularly in rural areas, households often lack awareness of the quality of water used for domestic purposes, which may lead to serious health risks. Therefore, this study aimed to identify water-security challenges in the rural community of Nelvoi Village, Vellore District, Tamil Nadu, India, through a Knowledge Exchange Project (KEP), community mapping and citizen science approach. The KEP with 40 marginal stakeholders revealed white precipitates in stored water, salt deposits during cooking, and skin dryness and irritation while bathing, with the community unaware of these groundwater quality issues. To address this concern, water infrastructure community mapping with 20 household representatives was conducted using printed maps to locate borewells, overhead tanks, and trace pipelines to each street. Further, citizens were trained to assess in-situ parameters and major ions (mg/L) in their domestic water using the VARIFY kit, with laboratory analysis validating the results. Representative citizens classified hardness and nitrate as severe, which was supported by laboratory results showing concentrations of pH (7.1–8), alkalinity (120–350), TDS (1017–1947), chlorides (111–510), sulphate (7–130), calcium (26–156), and magnesium (3–60) where within the IS 10500:2012, whereas hardness (230–677), nitrate (7–58) exceeding the IS limit of hardness (200 to 600) and nitrate (below 45 and no relaxation). This study shows the water quality issues stem from geogenic hardness in charnockite; citizen participation and scientific guidance eased fears, promoting feasible household solutions like boiling, filtering, and rainwater harvesting.

Keywords: *citizen science; community mapping; groundwater quality; rural water security*

WAT-120 ORAL PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Spatial Dipole in Bangladesh Meteorological Drought Trends (1971–2024) and Precipitation-Source Sensitivity of Reanalysis-Based SPEI

S. R. S. Chowdhury[1*], N. Ibnat[2], M. J. Bhuiyan[2] and F. Kabir[1]

[1]*Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh*
[2]*Military Institute of Science and Technology (MIST), Dhaka, Bangladesh*
**Corresponding author: shafquat.rakin@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.28

Abstract

Bangladesh's monsoon-dependent water security faces climate-driven pressure, yet station-level meteorological drought remains poorly characterized over multiple decades. The research analyzed daily rainfall from 44 Bangladesh Meteorological Department (BMD) stations (1971-2024) and computed Standardized Precipitation Index (SPI-3/6/12) for 32 stations having adequate record using gamma distribution. Drought events (SPI-12≤−1.0) were identified via run theory and classified as Moderate (−1.0 to −1.49), Severe (−1.5 to −1.99) or Extreme (≤−2.0). Trends were assessed using Mann-Kendall and Sen's slope for two periods (1971-1997 and 1998-2024). Results showed drought worsened in the northwestern Bangladesh while easing in the southeast. 531 drought events (96 extreme) occurred, with 26-of-32 stations showing significant SPI-12 shifts, northwestern/central Bangladesh drying (e.g. Faridpur: −0.84, $p<10^{-18}$), while southeastern coastal and hill-tract stations wetterd (e.g. Khepupara: +0.77, $p<10^{-9}$). SPI-1-based rapid intensification (>−0.5 to ≤−1.5 within one month) identified 431 flash drought onsets, alongside a spatially consistent Indian Ocean Dipole phase shift (Mann-Whitney U test, p=0.025). To test consistency, Standardized Precipitation Evapotranspiration Index (SPEI-3/6/12) was computed on three combinations using AgERA5(0.1°)/CHIRPS(0.05°)/BMD precipitation with AgERA5 evapotranspiration. Nearest grid-cells were matched to stations; 17 stations had sufficient overlapping record for comparisons. AgERA5-based SPEI showed an apparent dipole reversal not reproduced by CHIRPS or BMD based observations, with 16-of-17 stations confirming the original SPI-based dipole. This indicates AgERA5's precipitation term caused the reversal, revealing precipitation-source sensitivity in reanalysis-based drought indices for monsoon and orographic terrain. The study reveals a spatial meteorological drought dipole for Bangladesh and provides a reference methodology for future SPEI-based drought assessments in South Asia.

Keywords: *flash drought; Indian Ocean Dipole (IOD); meteorological drought; precipitation; reanalysis; SPI/SPEI*

WAT-28 ORAL PRESENTATION · WATER TRACK · COASTAL & MARINE WATER SYSTEMS

Subsurface Marine Heatwaves and Ocean Productivity Disruption in the Bay of Bengal, 2002–2020

A. Devan[1*], A. R. Adharsh[1], S. Gokul[1], and E. Yuvaraj[1]

[1]*Department of Coastal Disaster Management, Pondicherry University, Sri Vijaya Puram, India*

**Corresponding author: akhildevan2@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.29

Abstract

Marine heatwave (MHW) monitoring relies mostly on satellite-derived sea surface temperature (SST), potentially overlooking heat that accumulates below the surface. This study evaluates whether subsurface (50 m) ocean heat content (OHC)-based MHW detection reveals biological carbon pump disruption, measured through chlorophyll-a and net primary production (NPP) anomalies, that SST-based detection misses in the Bay of Bengal and Andaman Sea (2002–2020). Two independent basin-scale MHW event catalogues (subsurface, NRSC-NICES OHC: 109 events; surface, NOAA Coral Reef Watch: 117 events) were constructed using an identical area-fraction threshold method (≥5% of basin area for ≥5 consecutive days). Satellite chlorophyll-a and NPP anomalies were computed against contamination-excluded climatological baselines at lags of 0, 2, 4 and 6 weeks, with bootstrap and Mann–Whitney significance testing. Both methods showed significant productivity declines, intensifying with MHW severity. The 44 subsurface events with no matching surface signal still produced significant declines across all eight lag–variable combinations, with magnitudes exceeding the full subsurface catalogue average, showing that surface-only monitoring misses genuine, often severe, disruption events. The clearest, least-confounded finding concerned persistence rather than magnitude: surface-detected declines were significant only at 0–2 weeks ($p < 0.001$, 0.002) and faded by 4–6 weeks ($p = 0.201$, 0.851), whereas subsurface-detected declines remained significant at all lags for severe and extreme events. The surface-replicated NPP decline (−2.97%) closely matched published estimates (−2%), validating the approach; subsurface estimates were consistently larger (−5.48% to −6.95%). These findings establish subsurface OHC monitoring as a necessary complement to surface-based MHW detection for characterising ecological and biogeochemical impacts.

Keywords: *Bay of Bengal; biological carbon pump; chlorophyll-a; marine heatwave; net primary production; subsurface ocean heat content*

WAT-82 ORAL PRESENTATION · WATER TRACK · COASTAL & MARINE WATER SYSTEMS

Integrated Hydrogeochemical and Modelling Approaches for Seawater Intrusion Studies in Coastal Aquifers of Pondicherry and Tamil Nadu, India

K. Ramesh[1]*, D. S. Varshini[1], K. Srinivasamoorthy[1], A. R. Kanna[1], V. Gopalakrishnan[1]

[1]*Department of Earth Sciences, Pondicherry University, Puducherry, India.*

**Corresponding author: rameshk1996@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.30

Abstract

Coastal groundwaters globally face rising salinity threats from seawater intrusion (SWI) due to restricted recharge and extreme groundwater abstraction, mainly in coastal urban aquifers. This study inspects salinity evolution across multi-aquifers of coastal southeastern India using combined hydrogeochemical, statistical, and numerical modelling approaches and suggests sustainable management approaches. Groundwater samples were acquired during pre-monsoon (PRM) and post-monsoon (POM) seasons from five formations: Alluvium, Cuddalore Sandstone, Kadaperikuppam Limestone, Thuruvai Limestone, and Vanur-Ramanathapuram Sandstone, and analysed for ^{222}Rn, major, minor, trace, and rare earth elements. Results indicate distinct SWI signatures in Alluvium, Cuddalore, and Vanur–Ramanathapuram during both seasons, while slight seawater mixing was observed in coastal parts of Kadaperikuppam and Thuruvai formations during PRM. Self-organising maps and K-means clustering further identified salinity sources and SWI zones. Groundwater flow and solute transport modelling revealed SWI impacts primarily in Alluvium and Cuddalore formations, associated with intensive pumping from municipal wells near the shoreline. Maximum simulated saline plume migration reached 1.54 km inland, with chloride exceeding 700 mg L^{-1}. Under existing pumping trends, SWI is projected to extend 2.32, 2.76, and 3.10 km inland by 2033, 2043, and 2053, respectively. Surface-water rejuvenation, pumping-well reallocation, and rooftop rainwater harvesting were proposed as sustainable management measures. The management scenario produced groundwater level increases of 0.30–0.65 m (compared to the baseline value) and chloride reductions of 3.94–7.77 mg L^{-1} (compared to the baseline value), demonstrating its potential to mitigate SWI. The results provide a framework for sustainable management of multi-layered coastal aquifers under similar hydrogeological conditions worldwide.

Keywords: *groundwater modelling; hydrogeochemistry; machine learning; rare earth elements; seawater intrusion; trace elements*

WAT-92 ORAL PRESENTATION · WATER TRACK · COASTAL & MARINE WATER SYSTEMS

Remote Sensing and GIS-Based Environmental Sensitivity Index Mapping for Coastal Vulnerability Assessment along the Western Shoreline, Sri Lanka

J. De Silva[1*], H. Wijethunge[2] and R. Galappaththi[2]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management, Faculty of Engineering, University of Moratuwa, Katubedda, 10400, Sri Lanka*

[2]*Department of Earth Resources Engineering, University of Moratuwa, Katubedda, 10400, Sri Lanka*

**Corresponding author: chathuranga97.janith@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.31

Abstract

The Western shoreline coastal ecosystem is highly exposed to oil-spill impacts because of dense urban and industrial development, ecologically important habitats, major shipping routes, fuel-storage facilities, and proximity to Colombo Harbour, yet a spatially explicit Environmental Sensitivity Index (ESI) is not currently available to support response planning. This study developed an ESI for the coastline from Negombo to Kalutara, focusing on biodiversity-rich coastal habitats, using remote sensing and geographic information system techniques in Google Earth Engine. Sentinel-2 surface-reflectance imagery was used to derive the Normalized Difference Vegetation Index as an indicator of vegetation condition. The slope was calculated from the Shuttle Radar Topography Mission digital elevation model, Visible Infrared Imaging Radiometer Suite nighttime-light data represented human activity, and World Database on Protected Areas boundaries represented biodiversity significance. The four layers were clipped, preprocessed, normalized by min-max scaling, and integrated through a weighted linear combination, with a higher weight of 0.3 assigned to vegetation and slope because of retention and dispersion and 0.20 each was assigned to human activity and biodiversity. Slightly adjusting the weighted values leaves the high-sensitivity areas unchanged. The results produced at 30 m spatial resolution indicate low, moderate and high ESI sensitivity areas. Approximately 30% of the biodiversity-rich coastal habitats have high environmental sensitivity, with the most sensitive zones concentrated around aquatic and mangrove-rich areas. The findings show that satellite-derived indicators can provide a practical screening tool for prioritizing sensitive areas, spill-response resources, biodiversity rescue, and restoration planning. Field validation, seasonal analysis, and regular map updates are recommended to strengthen operational application and national oil-spill preparedness.

Keywords: *coastal vulnerability; environmental sensitivity index; geographic information system; oil spill; remote sensing*

WAT-109 ORAL PRESENTATION · WATER TRACK · COASTAL & MARINE WATER SYSTEMS

Spatial and Temporal Variability of Ocean Acidification Indicators in Negombo Lagoon and Adjacent Coastal Waters, Sri Lanka

P. Ashanka[1], R. S. Diyabalanage[2, 3], R. R. M. K. P. Ranatunga[1]*

[1]*Center for Marine Science and Technology, Department of Zoology, University of Sri Jayewardenepura, Sri Lanka*
[2]*Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Sri Lanka*
[3]*Instrument Centre, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka*
**Corresponding author: ranatunga@sci.sjp.ac.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.32

Abstract

Baseline information on the carbonate system of Sri Lankan lagoons and coastal waters remains limited, hindering the assessment of ocean acidification (OA) in these ecosystems. This study characterized spatial and temporal variability of OA-relevant indicators to establish a reference dataset for long-term monitoring. Sampling covered 14 sites within Negombo Lagoon and 11 in adjacent coastal waters during the Southwest and Northeast Monsoons. pH, dissolved oxygen, total dissolved solids, turbidity, electrical conductivity and salinity were measured in situ, while total alkalinity, chlorophyll *a* and nutrients were measured in the laboratory. Spatial and temporal variations were tested using two-way ANOVA. In the lagoon, pH ($p = 0.012$), salinity and total alkalinity ($p < 0.001$) varied significantly. In the lagoon, pH ($p = 0.012$), salinity and TA ($p < 0.001$) varied significantly over time. Lagoon pH ranged from 6.97 to 8.41, salinity from 0.10 to 33.32 ppt, and TA from 273 to 2713 µmol kg^{-1}. Coastal pH was 8.30–8.42 at the surface and 8.32–8.40 at 5 m, salinity 35.88–36.34 and 35.81–36.15 ppt, and TA 2359–2376 and 2360–2377 µmol kg^{-1}, respectively. The wide, freshwater-driven range of pH and TA in the lagoon reflects reduced, variable buffering capacity and heightened sensitivity to acidification, whereas the narrow offshore ranges indicate well-buffered, stable conditions. Since the sampling is limited to two monsoons and excluded DIC and pCO_2, these results show short-term variability rather than long-term trends and warrant fuller carbonate-system characterization.

Keywords: *coastal waters; Negombo Lagoon; ocean acidification; pH; total alkalinity*

WAT-61 ORAL PRESENTATION · WATER TRACK · GEO-HYDROINFORMATICS & DECISION SUPPORT SYSTEMS

Machine Learning for Flash Flood Prediction in Ungauged Basins: A Review of Global Applications and Their Relevance to Sri Lanka

M. M. J. R. Malwattegedara[1*], L. N. Gunawardhana[1] and R. L. H. L. Rajapakse[1]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: jayrasali101@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.33

Abstract

Flash floods rank among the most frequent hydrological hazards globally, causing repeated damage to lives, property and infrastructure, while reliable and timely warnings remain difficult to achieve. Many small and fast-responding river basins contain few, or no, streamflow gauging stations, leaving them effectively ungauged and difficult to model using conventional calibration methods. Machine Learning is a recently emerged promising alternative, as models trained on many gauged basins can learn the general relationship between rainfall and streamflow to estimate flow in basins where the local data are limited. This review examines how machine learning has been applied to streamflow and flash flood prediction in ungauged and data-scarce basins and evaluates its suitability across different settings, including Sri Lanka. A thematic literature review was combined with a bibliometric analysis under a systematic search protocol. Peer-reviewed articles published between 2015 and 2026, together with seminal studies, were retrieved from Scopus, Web of Science and ScienceDirect, and screened by the title, abstract and full text. Studies applying machine learning to streamflow or flash-flood prediction in ungauged or data-scarce basins were retained, while non-machine-learning and gauged-only studies were excluded, before keyword co-occurrence mapping and thematic synthesis. Machine learning reproduces ordinary, non-extreme flows well and matches or exceeds traditional models, but its skill weakens during extreme and consecutive flash-flood events, leaving interpretability and validation under such conditions limited. Key gaps persist in predicting rapid drought-to-flood transitions and compound events. By consolidating global evidence, this review maps these gaps and outlines directions applicable to ungauged basins worldwide.

Keywords: *bibliometric analysis; data-scarce catchments; rainfall-runoff modelling; regionalisation; transfer learning*

WAT-13 ORAL PRESENTATION · WATER TRACK · GROUNDWATER MODELLING & DISASTER RESILIENCE

Assessment and Characterization of Groundwater Resources for the Sustainable Water Supply of Animals at the Mawana Game Reserve (MGR, KwaZulu-Natal, South Africa)

W. S. D. Djomatchoua[1*]

[1]*University of Neuchatel, Neuchatel, Switzerland*

**Corresponding author: wilfried.djomatchoua@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.34

Abstract

Frequent droughts, occurring every 2 to 3 years, increasingly threaten the survival and well-being of wildlife, particularly vervet monkeys, at Mawana Game Reserve (MGR), South Africa, where reliable groundwater data remain scarce. This study characterized the water potential and hydraulic properties of the reserve's main aquifer to support sustainable, climate-resilient water provisioning for its animals. GIS, Remote Sensing, in situ water sampling, and hydrogeological modelling (Hydromodpy) were combined to simulate climate extremes, droughts and heavy rainfall, and to assess groundwater recharge between 2000 and 2023 (mean =103mm/yr), as well as to estimate the water potential of the unconfined Dwyka Tillite aquifer at the end of the simulated dry season (5months: May to September), under calibrated high- and low-water conditions (recharge =79 and 1mm/yr; storage =95.3 and 53.3 million m^3 over 5months). Hydraulic conductivity and specific yield of the aquifer were also calibrated ($5.08x10^{-7}$m/s, 1%) against the observed hydrographic network. Favorable groundwater zones were mapped from these simulations and validated using the Analytic Hierarchy Process (AHP), achieving 98% accuracy. Under limited field data, we corrected errors in established recharge formulas, improving precision 30-fold, refined regional satellite data resolution, and obtained hydraulic conductivity results 10 times more accurate than existing local estimates. These findings provide a validated basis for groundwater availability at MGR during climate extremes, supporting borehole siting and sustainable water provisioning for wildlife, with relevance for other protected areas facing similar climate pressures in data-scarce, logistically constrained settings typical of sub-Saharan Africa.

Keywords: *climate-resilience; data-scarce environments; groundwater; hydrogeology; water supply*

WAT-68 ORAL PRESENTATION · WATER TRACK · GROUNDWATER MODELLING & DISASTER RESILIENCE

An Event-Adaptive Coupling Architecture for Simulating Non-Stationary Baseflow–Recharge Partitioning in Groundwater–Surface Water Systems under Hydroclimatic Whiplash

N. K. Meshram[1*]

[1]*Department of Civil Engineering, Sandip Institute of Technology and Research Centre, Nashik, India*
**Corresponding author: nilesh.meshram.office@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.35

Abstract

Groundwater-surface water interaction (GSI) is increasingly disrupted not by gradual climate change but by hydroclimatic whiplash (rapid, compounding transitions between drought and flood). SWAT-MODFLOW, the leading coupled GSI tool, exchanges data between its surface and subsurface components on a fixed (commonly monthly) schedule that cannot resolve partitioning during the fastest-changing days. This study develops an Event-Adaptive Coupling Architecture (EACA) that switches the exchange interval from 30 days to 1 day when a hydroclimatic-stress trigger, defined as a dry spell of at least 15 days followed by a precipitation anomaly exceeding 1.5 standard deviations, is detected, relaxing once the event subsides. A companion Baseflow-Recharge Partitioning Index (BRPI), defined as the time-varying ratio of baseflow to total streamflow, tracks non-stationary shifts in this partitioning rather than reporting a single long-term average. As no field site was specified, the framework was tested on a transparent synthetic experiment: a 30-year stochastic precipitation record with an intensifying whiplash signature drove a two-store conceptual analogue of a coupled system under always-daily, fixed-monthly, and adaptive coupling. Relative to fixed-monthly coupling, the adaptive scheme reduced mean peak-magnitude error across twelve whiplash events from 62.2% to 50.1% and reduced BRPI error within active stress windows by 6.5%, using only 13% of the exchanges required by always-daily coupling. These synthetic, proof-of-concept results suggest that event-adaptive coupling could improve SWAT-MODFLOW-type simulation of climate extremes, though field validation with observed hydrogeological data is needed before the approach can be recommended for operational use.

Keywords: *adaptive coupling; baseflow–recharge partitioning; groundwater–surface water interaction; hydroclimatic whiplash; non-stationarity*

WAT-83 ORAL PRESENTATION · WATER TRACK · GROUNDWATER VULNERABILITY & CLIMATE RISK REDUCTION

From Anthropogenic Hazard to Groundwater Risk: Hydrostratigraphic and Recharge Controls in a Multi-Aquifer Coastal System

D. S. Varshini[1*], K. Ramesh[1], K. Srinivasamoorthy[1]

[1]*Department of Earth Sciences, Pondicherry University, Puducherry, India.*

**Corresponding author: supriya.mourthy@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.36

Abstract

Groundwater resilience in tropical coastal regions is a function of contaminant loads, as well as the hydrostratigraphic framework. The study is based on a GIS-integrated approach to assess the vulnerability (natural susceptibility to contamination) and risk (potential to affect groundwater quality) of the aquifers of Alluvium, Cuddalore Sandstone, Kadaperikuppam and Thuruvai Limestone, and Vanur-Ramanathapuram Sandstone in Puducherry and Tamil Nadu, Southeast India. The framework incorporates hydrostratigraphy, recharge accessibility, groundwater and hazards from agricultural and domestic use. Results indicate that 72.5% of the study area falls under moderate to very high intrinsic vulnerability, with 45.4% under high to very high vulnerability. Although 82.0% of the area experiences high to very high hazard along the eastern and eastern-central coast, only 6.85% has very high risk, while 35.67% has high risk, primarily in shallow alluvial and coastal-transition zones. This contrast highlights the change in recharge accessibility and confinement in controlling the groundwater risk induced by anthropogenic hazards. Groundwater risk and health response correlated significantly with aquitard thickness ($\rho = -0.49$, $p < 0.001$; $\rho = -0.21$, $p < 0.001$, respectively), but aquifer thickness was not significantly correlated with groundwater health response, highlighting the greater influence of confinement. The nitrate-based non-carcinogenic health index (HI) was directly calculated from nitrate concentration, resulting in a perfect correlation ($\rho = 1.00$, $p < 0.001$). Fractured limestone shows variable responses, with preferential transport of contaminants increasing during post-monsoon recharge. Findings provide an aquifer-specific basis for prioritising groundwater risk reduction and climate-sensitive water-resource management in coastal areas.

Keywords: *anthropogenic hazard; coastal aquifers; groundwater vulnerability; hydrostratigraphy; recharge dynamics*

WAT-123 ORAL PRESENTATION · WATER TRACK · GROUNDWATER VULNERABILITY & CLIMATE RISK REDUCTION

Seasonal Evaluation of Groundwater Quality and Health Risks Associated with Chromium in the Ranipet Industrial Region of Tamil Nadu, India, Employing the Water Quality Index and Age-Specific Risk Assessment

V. R. Lakshmanan[1*], L. Krishnamoorthy[2]

[1]*Associate Professor, School of Civil Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India;*
[2]*Research Scholar, School of Civil Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India*

**Corresponding author: vigneshrajkumar.l@vit.ac.in,*

DOI: https://doi.org/10.31705/ICEWSE.2026.37

Abstract

Assessing groundwater quality is crucial in industrial areas where human activity may compromise drinking water safety. This study evaluated seasonal groundwater quality and chromium (Cr)-related health hazards in the Ranipet industrial area, Tamil Nadu, India, using the Water Quality Index (WQI) and age-specific health risk assessment, based on 206 groundwater samples collected seasonally and analysed for physicochemical parameters and heavy metal concentrations. Pre-monsoon, samples were classified as 1% excellent, 32.04% good, 42.72% poor, 13.59% very poor, and 10.68% unsuitable for drinking. Post-monsoon, this shifted to 0.97% excellent, 8.74% good, 17.48% poor, 33.01% very poor, and 39.81% unsuitable. Mean chromium concentrations rose from 0.0085 to 0.1824 mg/L between pre- and post-monsoon periods, with a maximum of 2.465 mg/L recorded post-monsoon. Health-risk assessments mean HQ for children rising from 0.166 to 3.564 and for adults from 0.120 to 2.583, showing a rising non-carcinogenic risk post-monsoon. Mean ILCR increased from 3.0×10^{-6} to 6.6×10^{-5} for children and 7.0×10^{-6} to 1.59×10^{-4} for adults. Samples exceeding the ILCR threshold ($>1 \times 10^{-4}$) increased from 0.97% to 29.13% of children and 2.91% to 46.60% of adults. The increase in Cr concentration coincided with WQI deterioration, with mean WQI increasing from 65.99 to 100.46 and very poor/unsuitable samples increasing from 24.27% to 72.82%. These results show a marked seasonal decline in groundwater quality and an increase in Cr-related health risks post-monsoon. The combined WQI and health-risk framework shows groundwater risk hotspots and underscores the need for continuous monitoring in the Ranipet industrial region.

Keywords: *groundwater quality; health risk assessment; industrial contamination; seasonal variation; water quality index*

WAT-44 ORAL PRESENTATION · WATER TRACK · HYDROGEOCHEMICAL PATHWAYS FOR SUSTAINABLE INFRASTRUCTURE

Assessment of Trace Metal Distribution and Drinking Water Suitability of Dug Wells across Urban, Suburban and Rural Areas in Batticaloa District, Sri Lanka

T. A. Farween[1*] and A. J. M. Harris[1]

[1]*Department of Zoology, Faculty of Science, Eastern University Sri Lanka, Vantharumoolai, Chenkalady, Sri Lanka*

**Corresponding author: maafrah36@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.38

Abstract

Dug wells serve as a primary drinking water source in Batticaloa, where increasing anthropogenic activities may influence groundwater quality. This study assessed trace metal distribution along with physicochemical and microbiological parameters from 18 dug wells across urban (W_1–W_6), suburban (W_7–W_{12}) and rural (W_{13}–W_{18}) areas to evaluate their suitability for drinking. A total of 12 sampling rounds were conducted, yielding 432 samples which were collected at two-week intervals between February and August 2025 and analyzed using standard methods, including inductively coupled plasma-optical emission spectrometry (ICP-OES) for elemental analysis and membrane filtration for microbiological assessment. Water quality was evaluated using the Canadian Council of Ministers of the Environment Water Quality Index (CCME-WQI), compared with Sri Lankan (SLS 614:2013) and World Health Organization drinking water standards. Trace metal concentrations exhibited spatial variation, with Ni detected only in urban wells and Cd exclusively in suburban wells, while Pb, Cr, Co, and Be were not detected in any samples. Metal pollution indices, including the Heavy Metal Evaluation Index (HMEI), Heavy Metal Pollution Index (HPI), Degree of Contamination (C_{deg}), and individual Pollution Index (P_i), further confirmed that there is no significant trace metal contamination (HMEI = 0.86–0.94; HPI = 0.85–1.62; C_{deg} = −14.06 to −14.13; P_i = 0–0.37). Significant differences among land-use categories were observed ($p < 0.05$) for Ca (0.00–52.55 ppb), Mg (1591.87–18837.16 ppb), K (0.83–32.50 ppm), Cu (0.00–4.74 ppb), Zn (0–115.13 ppb), Ag (0.00–2.44 ppb), and Li (0.55–15.12 ppb), indicating the spatial variability in distribution of trace metals. However, all detected trace metals remained well below drinking water permissible limits. Microbiological contamination was widespread, with total coliforms and *Escherichia coli* detected in all wells except W_{18}. The CCME-WQI classified water quality ranging from excellent (W_{14}) to fair (W_2), with rural wells scoring comparatively better overall water quality (WQI > 80). Although trace metal contamination was not a concern, the widespread coliform contamination indicates that dug well water is unsuitable for direct consumption without appropriate treatment. Continuous monitoring, improved sanitation practices, and proper household water treatment are therefore recommended to ensure drinking water safety in Batticaloa District.

Keywords: *coliform; dug well; trace metal; water; water quality index*

WAT-38 ORAL PRESENTATION · WATER TRACK · IRRIGATION & AGRICULTURAL WATER MANAGEMENT

Assessment of Crop Water Requirement of *Capsicum chinense* Grown in a Protected House: A Stable Water Isotope Based Method

S. A. S. Tharundya[1,2*], R. R. U. R. Perera[1], E. A. N. V. Edirisinghe[1], N. S. Withanage[2], G. Abhiram[2], S. Priyadarshanee[1], M. Kalpage[1] and H. P. K. Liyanage[1]

[1]*Sri Lanka Atomic Energy Board, Orugodawatta, Wellampitiya, Sri Lanka*
[2]*Department of Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka*
**Corresponding author: stharundya@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.39

Abstract

Sri Lanka is an agricultural country facing several challenges. One of them is that available accessible fresh water is limited for the crop fields. This study aimed to enhance the agronomic performance and Water Use Efficiency (WUE) of Scotch Bonnet (*Capsicum chinense*) under different irrigation levels in a protected house. The experiment was conducted using a Completely Randomized Design with three irrigation treatments and 12 replicates per treatment. Three irrigation treatments were implemented based on Total Available Water (TAW) and Allowable Depletion Levels of the potting mixture. Treatment 01 plot was maintained at 60% moisture of TAW, Treatment 02 at 40% and Treatment 03 at 25%. Once the specified depletion level was reached, each pot was irrigated according to the estimated Net Irrigation Requirement to reinstate soil moisture to Field Capacity. Growth parameters were measured weekly. Stable Water Isotopes were analyzed using water extracted from soil and leaf samples by Vacuum Cryogenic Extraction. WUE is calculated as the yield produced per unit of water used through evapotranspiration. The results revealed that, during transpiration, lighter isotopes (^{1}H and ^{16}O) leave the leaves more easily, while heavier isotopes (^{2}H and ^{18}O) became relatively enriched in leaves. Stable water isotopes extracted from leaf, soil, and atmospheric moisture samples formed three separate clusters around the Local Meteoric Water Line. Isotope data showed distinct signals from evaporation, transpiration, and evapotranspiration. WUE values for T1, T2, and T3 were 0.00058, 0.0017, and 0.0050 kg L^{-1}, respectively. Overall T3 showed the best growth, yield, and WUE. These isotope differences helped distinguish evaporation from transpiration and explain water movement through the soil–plant–atmosphere system.

Keywords: *agronomic performance; evapotranspiration; stable water isotopes; vacuum cryogenic extraction; water use efficiency*

WAT-70 ORAL PRESENTATION · WATER TRACK · IRRIGATION & AGRICULTURAL WATER MANAGEMENT

A Remote Sensing-Based Geospatial Framework for Assessing Crop Water Dynamics

B. H. I. A. Jayathissa[1*] and M. Leh[1]

[1]*International Water Management Institute (IWMI), Colombo, Sri Lanka*

**Corresponding author: i.jayathissa@cgiar.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.40

Abstract

Food security depends on reliable agricultural production, and effective water management is essential for achieving good crop yields. Irrigated agriculture covers approximately 20% of cultivated land and produces about 40% of global food, while agriculture accounts for approximately 69% of global freshwater withdrawals (FAO AQUASTAT). Crop water requirements are commonly estimated using the FAO-56 approach, which uses crop coefficients (Kc) for different growth stages. However, applying this approach across large agricultural areas requires detailed information on crop type and development. This study combines a maize crop map with satellite-based Normalized Difference Vegetation Index (NDVI) data to estimate maize water requirements. The crop map identified maize fields; monthly NDVI described their development. A linear relationship between NDVI and Kc was used to estimate monthly Kc values. Crop evapotranspiration (ETc) was then calculated using Kc and reference evapotranspiration (ETo) and compared with satellite-derived actual evapotranspiration (ETa). The approach was applied to maize-growing areas in Guanajuato, Mexico, from 2021 to 2024 at 30-m spatial resolution. Seasonal Kc patterns identified growing periods. Areas where ETa was lower than ETc were identified as potential crop water deficit areas. Seasonal ETc of 658-792 mm against ETa of 514-567 mm gave mean deficits of 110-226 mm over 91-97% of the maize area. These differences may indicate water stress but do not directly confirm stress because of uncertainties in the input data and water-use estimates. The approach provides spatially detailed information on maize water requirements and potential deficits, supporting improved crop water monitoring and irrigation management.

Keywords: *agriculture; crop coefficient; remote sensing; water*

WAT-80 ORAL PRESENTATION · WATER TRACK · IRRIGATION & AGRICULTURAL WATER MANAGEMENT

Seasonal Irrigation Return Flow Coefficients in Dry-Zone Sri Lanka: An Integrated Water Balance and Hydrological Modelling Framework

S. P. J. Thisurika[1,2*], P. K. C. De Silva[1,2], H. G. L. N. Gunawardhana[1,2] and R. L. H. L. Rajapakse[1,2]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa, Sri Lanka*

[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: thisurikaspj.25@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.41

Abstract

Irrigation return flow (RF), the fraction of applied irrigation water not consumed by the crop that re-enters the hydrological system as surface drainage or subsurface flow, is a critical component of agricultural water balances that is often represented by a single fixed coefficient regardless of season or site conditions. This study develops a season and site-sensitive framework for estimating irrigation return flow coefficients in two paddy-dominated dry-zone basins of Sri Lanka, sub-basins of the Kala Oya and Yan Oya basins. Seasonal crop-water requirements were estimated using CROPWAT, a crop water-requirement model with NASA POWER climate data and compared against recorded irrigation-supply volumes, to derive a seasonal water-balance residual interpreted as potential return flow. As direct measurements of return flow were unavailable, the estimated residual may incorporate uncertainties associated with irrigation supply records, climatic inputs, and changes in system storage. Therefore, the derived coefficients are interpreted as effective seasonal estimates rather than direct measurements of return flow. This residual was subsequently incorporated into a HEC-HMS hydrological model using source elements to simulate their influence on streamflow. Kala Oya showed a stable Maha-season return flow coefficient of 0.525 during calibration and 0.555 during validation, while Yala coefficients were close to zero. In Yan Oya, return flow coefficients were lower, ranging from 0.090–0.119 in Yala and 0.000–0.017 in Maha. These differences reflect contrasting seasonal rainfall, irrigation releases, and basin operating conditions. The baseline HEC-HMS models produced NSE values of 0.52 for Kala Oya and 0.63 for Yan Oya. Incorporating the season-specific return flow coefficients increased NSE to 0.55 and 0.64, respectively, demonstrating improved representation of basin streamflow compared with the baseline modelling approach. The results indicate that irrigation return flow cannot be reliably represented using a single universal coefficient and that seasonal water balance, irrigation operation, and site-specific hydrological conditions should be considered together for improved irrigation-water accounting and management in data-limited dry-zone basins.

Keywords: *CROPWAT; dry-zone paddy irrigation; HEC-HMS; Yala–Maha seasonality*

WAT-86 ORAL PRESENTATION · WATER TRACK · IRRIGATION & AGRICULTURAL WATER MANAGEMENT

Optimizing the Maha-Cultivation Calendar to Enhance Water-Use Efficiency and Support Third-Season Cropping in the Akkarayan Irrigation Scheme, Sri Lanka

K. M. Aafir[1*], H. A. T. N. Perera[1,2], N. Saheedha[1], S. Narmathan[3] and A. L. Manasar[3]

[1]*Faculty of Graduate Studies, University of Ruhuna, Matara, Sri Lanka*
[2]*Faculty of Earth and Environmental Sciences and Engineering, University of Miskolc, Miskolc, Hungary*
[3]*Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka*
**Corresponding author: kmaafir@fgs.ruh.ac.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.42

Abstract

The efficient utilization of irrigation water is critical for enhancing agricultural productivity in Sri Lanka's dry zone, where water scarcity and increasing climatic variability pose significant challenges to sustainable cultivation. The Akkarayan irrigation scheme in Kilinochchi District suffers from a long fallow season between Maha and Yala seasons despite having reservoir storage after the Maha season. This study examined the feasibility of growing the third season (mid-season) water-use efficiency for Akkarayan scheme. A water balance analysis was conducted using reservoir characteristics, 80 years of rainfall records, evaporation data, crop water requirements, and irrigation system efficiencies. Monthly inflows were estimated using Mod Group rainfall derived from long-term rainfall records, while crop water requirements for a 105-day paddy crop were incorporated into the water balance assessment. Four alternative Maha cultivation commencement dates (1 October, 15 October, 1 November, and 15 November) were evaluated for a 105-day paddy crop under a command area of 3,550 acres. The results showed that commencing cultivation on 1 October retained the highest post-Maha reservoir storage of 11,912 acre-ft, while 15 October retained 11,803 acre-ft. However, the 15 October option achieved the lowest irrigation duty of 0.99ft and irrigation demand of 3,500 acre-ft, compared with 1.12 ft and 3,961 acre-ft for the 1 October option. Delayed cultivation increased irrigation duties to 1.57 ft and 2.14 ft for the 1 November and 15 November options, respectively, while reducing residual storage. The results show that water-use efficiency can be significantly enhanced and adequate water storage can be maintained for possible mid-season cultivation. The study serves as a practical basis for irrigation scheduling and planning of reservoir operation for increasing cropping intensity, agricultural production and farmer livelihood in dry-zone irrigation schemes.

Keywords: *irrigation scheduling; mid-season cultivation; paddy cultivation; reservoir management; water balance analysis; water-use efficiency*

WAT-88 ORAL PRESENTATION · WATER TRACK · IRRIGATION & AGRICULTURAL WATER MANAGEMENT

Pollution Load and Assimilative Capacity of an Urban Tropical Lake: A Case Study of Boralesgamuwa Lake, Sri Lanka

H. U. Isuranga[1], J. K. S. Rashmika[1], D. D. Dissanayake[1], K. A. Perera[1], N. Wickramasena[2] and S. A. M. A. I. K. Senanayake[1*]

[1]*Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Irrigation Department, Colombo, Sri Lanka*
**Corresponding author: indunil@sci.sjp.ac.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.43

Abstract

Boralesgamuwa Lake is a shallow, perennial urban water body situated within the highly urbanized Colombo District, Sri Lanka. It holds notable ecological, economic and hydrological significance. Its ongoing degradation is progressively compromising these functions and values. Water quality assessed at five stations across wet and dry seasons showed chemical oxygen demand (COD) up to 102–105 mg L^{-1} (CEA limit: 10 mg L^{-1}), traced to an inlet near an illegal solid-waste disposal site. Ortho-phosphate exceeded the OECD eutrophication threshold (0.03 mg L^{-1}) at every station by factors of 5–41, while nitrate remained within WHO guidelines, identifying phosphorus as the primary eutrophication driver. COD loads escalated sharply in the wet season, with the assimilative-capacity deficit for COD nearly 16 times greater than in the dry season, reflecting strong seasonal control. Assimilative capacity, calculated from the standard background concentration difference and outflow discharge, showed the lake has fully exhausted its capacity for phosphate and organic loads while retaining residual capacity for nitrate. Long dry-season hydraulic retention (exceeding 100 days) intensifies internal nutrient cycling and bloom risk, supported by widely fluctuating dissolved oxygen (4.7–11.4 mg L^{-1}), elevated BOD_5, *E. coli* exceeding recreational standards, and dominance of the cyanobacterium *Microcystis aeruginosa*. Heavy metals remained below detection limits, indicating the pollution is organic and microbial rather than metallic in origin. Based on this single sampling event per season, these findings indicate that Boralesgamuwa Lake has exceeded its environmental carrying capacity for phosphorus and organic pollutants. It emphasizes the importance of source control and nature-based remediation methods.

Keywords: *assimilative capacity; Boralesgamuwa Lake; eutrophication; urban lake pollution; water quality*

WAT-100 ORAL PRESENTATION · WATER TRACK · IRRIGATION & AGRICULTURAL WATER MANAGEMENT

Copula-Based Agricultural Drought Risk Zonation in Sri Lanka Using Era5 Re-Analysis Data for Climate-Resilient Farming

T. M. N. Peiris[1,3*], H. M. R. C. Herath[1], R. M. P. Fernando[1], A. R. Warnasuriya[1], S. Viswakula[2] and D. Halwatura[3]

[1]*Department of Meteorology, Colombo 07, Sri Lanka*
[2]*Department of Statistics, University of Colombo, Colombo 03, Sri Lanka*
[3]*Department of Zoology and Environment Sciences, University of Colombo, Colombo 03, Sri Lanka*
**Corresponding author: nandalalpeiris@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.44

Abstract

Drought is a recurrent, spatially heterogeneous hazard in Sri Lanka with major impacts on agriculture, water resources, and socio-economic stability. Conventional single-index assessments often fail to capture the interdependence among drought duration, severity, and frequency that governs actual agricultural impact. This study develops a spatially explicit, multivariate drought severity-duration-frequency (SDF) framework for agricultural drought risk zonation, using ERA5 reanalysis data at 0.1°×0.1° resolution for 1960–2025. Three indices were computed at 3-, 6-, and 9-month timescales: the Standardized Precipitation Index (SPI) for meteorological drought, the Standardized Precipitation Evapotranspiration Index (SPEI) to incorporate evapotranspiration demand, and a Composite Drought Index (CDI), formed by combining multi-timescale SPI with a Soil Moisture Anomaly term and normalized to a 0–1 scale, where 0 denotes no drought and 1 denotes extreme drought, to trace drought progression from meteorological deficit to vegetation stress. CDI-based analysis identified eight major national drought episodes, namely 1972, 1975, 1976–77, 1982–83, 1987–88, 1992–93, 2017–18, and 2023–24, plus moderate events in 1979, 1989, and 2020, consistent with documented drought records. Since univariate indices cannot jointly represent severity, duration, and frequency, a copula-based approach modeled their joint dependence, and fitted bivariate distributions were validated and used to construct SDF curves for 5-, 10-, 20-, and 50-year return periods. The resulting spatially distributed SDF curves and drought hazard maps delineate agricultural drought risk zones and hotspot areas where compound conditions exceed critical thresholds for rice production, translating return periods into actionable indicators for irrigation planning, drought preparedness.

Keywords: *climate-resilient farming; composite drought index (CDI); copula; droughts; severity-duration-frequency*

WAT-26 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Comparative Evaluation of *Bunchosia armeniaca* Plant-Derived Silver Nanoparticles for Catalytic and Photocatalytic Environmental Remediation

A. D. Dilan[1], B. Gunaratne[1], O. Perera[1] and M. Kandiah[1*]

[1]*Faculty of Life and Medical Sciences, BMS Campus, 591, Galle Road, Colombo 00600, Sri Lanka*

**Corresponding author: mathi@bms.ac.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.45

Abstract

Plant-mediated synthesis of silver nanoparticles (AgNPs) is widely explored; however, comparative evaluation of AgNPs synthesized using aqueous extracts from different plant parts for catalytic and photocatalytic applications remains limited. This study investigated AgNPs biosynthesized using water extracts of *Bunchosia armeniaca* parts (bark, leaf, root, flower, and fruit), selected for their varied phytochemical composition, potentially influencing AgNP properties. AgNP formation was confirmed by colour change and UV–Vis spectroscopy, with synthesis optimized at 90°C for 60 minutes. Scanning electron microscopy and zeta-potential analysis revealed spherical AgNPs of 55-75 nm with -29.1mV surface charge. Catalytic activity was evaluated using 2 mL of 0.1 mM p-nitrophenol, 1 mL of 0.1 M $NaBH_4$, and 25–75 µL AgNPs (4000 ppm). Flower-AgNPs (50 µL) exhibited the highest rate constant (pseudo-first-order kinetics, $k = 0.090 \pm 0.002$ min^{-1}), with degradation achieved within 10 minutes. Photocatalytic degradation of methyl orange was evaluated under solar irradiation in the presence and absence of $NaBH_4$. Degradation occurred only in the presence of $NaBH_4$, with Root-AgNPs (4000 ppm) achieving near-complete degradation within 1 minute, while Fruit-AgNPs exhibited the next highest rate constant ($k = 0.0879 \pm 0.0011$ min^{-1}) within 20 minutes. Preliminary toxicity assessment using *Artemia salina* (2 per well), exposed to 200 and 800 ppm AgNPs for 24 hours under illumination, showed 100% viability at 200 ppm for all treatments; however, at 800 ppm, Bark-AgNPs and Root-AgNPs displayed reduced viability. These findings highlight the influence of plant parts on AgNP performance and their potential for pollutant remediation.

Keywords: *Bunchosia armeniaca; catalysts; environmental remediation; green synthesis; photocatalysis; silver nanoparticles (AgNPs)*

WAT-42 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Translating Blue-Green Infrastructure Principles into Urban Practice: Development of a Scoring-Based Implementation Toolkit

R.M. Kollarath[1*] and J. Chadchan[1]

[1]*School of Architecture, Christ University, Bengaluru, India*

**Corresponding author: reshmimk@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.46

Abstract

In recent times Blue Green Infrastructure (BGI) has emerged as an effective strategy for managing water challenges in urban areas. Several researches have highlighted the efficacy of BGI and Nature based Solutions (NbS)in effective water management in urban areas. BGI involves integrating features such as bioswales, green roofs and permeable pavements for water harvesting and flood control in the cities. Despite the multifunctional benefits of implementing BGI and NbS which includes enhancing livability and improving resident health benefits, there are very few cities who have mandated BGI in their urban planning policies. The paper explores the necessity of developing an assessment framework in cities which will enable planners and authorities in implementing context driven BGI solutions in their cities. The paper explores the need for developing a comprehensive assessment framework for BGI that responds to the environmental, spatial, social, and institutional characteristics of individual cities. It examines existing BGI assessment frameworks and evaluation methodologies developed and implemented across different geographical contexts. The study critically reviews these frameworks with respect to their objectives, assessment parameters, indicators, scales of application, and implementation mechanisms. A comparative analysis is undertaken to identify common assessment criteria, context-specific parameters, and gaps in existing approaches. Based on these findings, the paper identifies the key components required for a context-driven BGI assessment framework. Such a framework can support evidence-based decision-making and enable urban planners and authorities to adopt BGI solutions that are locally appropriate, resilient, and aligned with broader goals of sustainable urban development.

Keywords: *assessment framework; blue green infrastructure; resilience; urban development; water management*

WAT-87 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Biosorbents for Simultaneous Removal of Fluoride and Hardness in Drinking Water: Comparative Evaluation of *Musa spp.* (Embul and Seeni) Pseudostem Fibers

D. D. Dissanayake[1*], J. K. S. Rashmika[1], J. D. Silva[1], K. A. Perera[1], A. Cooray[2], and S. A. M. A. I. K. Senanayake[1]

[1]*Department of Zoology, University of Sri Jayewardenepura, Gangodawila, Sri Lanka*
[2]*Department of Chemistry, University of Sri Jayewardenepura, Gangodawila, Sri Lanka*
**Corresponding author: indunil@sci.sjp.ac.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.47

Abstract

Fluoride and water hardness contamination of groundwater in Sri Lanka's dry zone poses severe health risks, including dental and skeletal fluorosis and chronic kidney disease of unknown aetiology (CKDu). Conventional treatment technologies are infeasible for off-grid rural communities. This study evaluated banana pseudostem (BPS) fibers from two Sri Lankan varieties, Musa spp. (Embul, AAB) and Musa spp. (Seeni, ABB), as biosorbents for simultaneous fluoride and hardness removal. Mechanically extracted fiber yields were 9.86% (Embul) and 7.32% (Seeni), with mean widths of 185.2 µm and 87 µm. FTIR spectroscopy confirmed hydroxyl, carboxylate, and carbonyl groups facilitating binding. Batch experiments using synthetic solutions optimized adsorbent dosage, initial concentration, pH, and contact time. Under optimal conditions, fluoride removal reached ~60% (Seeni) and ~69% (Embul), while hardness removal reached ~56% (Seeni) and ~58% (Embul). Musa spp. (Embul) significantly outperformed Musa spp. (Seeni) across removal efficiencies ($P<0.05$). Higher initial concentrations increased overall adsorption capacity, which indicates once available site bonded, further adsorption is limited. Peak fluoride removal occurred at pH 2 and 10, whereas hardness removal increased steadily with alkaline pH. Equilibrium was reached at 70 (Embul) and 90 minutes (Seeni). Fluoride adsorption fitted the Langmuir monolayer model ($R^2=0.7971$), indicating fluoride adsorption onto a relatively homogeneous surface area of BPS, whereas hardness removal showed poor fit to Langmuir ($R^2=0.1894$) and Freundlich ($R^2=0.2378$) models, indicating complex multi-mechanism binding. Considering the removal efficiency of the fluoride and hardness, the BPS fibers provide a promising and eco-friendly approach for water treatment, while it can be used as a low-cost adsorbent for improving water quality.

Keywords: *banana pseudostem; biosorption; fluoride; Musa spp.; water hardness; water treatment*

WAT-97 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Assessing Treated Municipal Wastewater for Irrigation Suitability and Nutrient Reuse Potential Using Biochar- and Ceramic-Based Constructed Wetlands in Dhaka, Bangladesh

S. T. Zaman[1*], S. Akther [1], Hassan Md. R[1], Mikko Kuusisto[2]

[1]*University of Asia Pacific, Dhaka, Bangladesh*
[2]*Centria University of Applied Sciences, Kokkola, Finland*
**Corresponding author: syedtakrimzaman@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.48

Abstract

Rapid urbanization in Dhaka is intensifying municipal wastewater generation while straining freshwater resources, making treated wastewater an attractive alternative for irrigation and nutrient recovery. This study evaluates the treatment performance, irrigation suitability, and nutrient-reuse potential of a three-stage combined constructed wetland treating municipal wastewater. Two configurations were assessed: a biochar-media system and a ceramic-aggregate system, each comprising two vertical-flow stages followed by a floating constructed wetland planted with Phragmites. Weekly influent and final-effluent samples were collected over eight weeks (n=8) and analyzed for nitrogen species, TN, TP, BOD_5, COD, TSS, TDS, E. coli, pH, dissolved oxygen, and redox potential. The biochar system achieved mean removals of 62.3% BOD_5, 33.4% COD, 35.3% TSS, 10.8% TP, and 48.0% E. coli, while the ceramic system achieved 66.0%, 41.9%, 44.6%, 7.9%, and 54.3%, respectively. TN increased by 22.0% in the biochar effluent but decreased by 24.1% in the ceramic system, reflecting nitrate dynamics. Mean effluent TDS was 416 mg/L (biochar) and 460 mg/L (ceramic), with near-neutral pH (7.49 and 7.47), indicating low and slight-to-moderate salinity restriction under FAO criteria, respectively. However, nitrate-N exceeded the severe-restriction threshold in the biochar effluent (31.1 mg/L) but remained slight-to-moderate for ceramic (17.0 mg/L). Since SAR, chloride, boron, and additional microbial indicators were not measured, the irrigation-suitability conclusion remains qualified. Nutrients were absorbed by the filtration media with theoretical fertilizer equivalents of Tk 3.56/m^3 (biochar) and Tk 2.80/m^3 (ceramic), representing reuse potential rather than realized savings. Decentralized constructed wetlands can therefore serve as a partial irrigation and nutrient-reuse pathway, but require microbiological monitoring, nutrient management, and site-specific hazard assessment

Keywords: *circular water management; irrigation reuse; nutrient recovery; waste-derived media; wastewater treatment; water–nutrient–food–waste nexus*

WAT-99 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Evaluating Nature-Based Solutions for Flood Mitigation under Single and Consecutive Extreme Storm Events in the Attanagalu Oya Basin, Sri Lanka

H. D. O. N. Sandamini[1,2*], T. M. N. Wijayaratna[1,2], L. N. Gunawardhana[1,2] and R. L. H. L. Rajapakse[1,2]

[1]*UNESCO-Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa 10400, Sri Lanka*

[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: sandaminihdon.25@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.49

Abstract

Flood hazard assessments commonly focus on isolated extreme rainfall events and may underestimate flood impacts associated with consecutive storms and antecedent catchment conditions. This study evaluates the effectiveness of spatially prioritized Nature-Based Solutions (NBS) for flood mitigation under single and consecutive extreme storm events in the Attanagalu Oya Basin, Sri Lanka. Priority areas for NBS implementation were identified by mapping the spatial mismatch between Flood Regulation Services (FRS) supply and demand, with areas of higher unmet flood-regulation demand prioritized for intervention. Hydrological and hydraulic responses were simulated using HEC-HMS and HEC-RAS 2D models. Storm events were classified as consecutive events based on the occurrence of multiple extreme rainfall events within a defined inter-storm period, allowing the influence of antecedent catchment conditions to be evaluated. A total of seven storm scenarios, comprising three single storm events and four consecutive storm events, were evaluated. The HEC-HMS model achieved Nash-Sutcliffe Efficiency values of 0.746 and 0.700 during calibration and validation, respectively. Flood simulations showed increasing inundation with storm severity, reaching 68 km^2 and 76 km^2 under the single 50-year and single 100-year storm events, respectively. Consecutive storms generated greater impacts, with the 50-year–50-year scenario producing 82 km^2 of inundation and the 25-year–50-year–25-year sequence producing the maximum inundated area of 95 km^2. Paddy-field-based NBS were evaluated through terrain deepening and bund enhancement. The combined scenario of 1.0 m paddy-field deepening and 0.5 m bunding achieved the greatest inundation reduction, reaching 20.6% under the single 50-year storm event, while reductions of 15.8% and 14.6% were achieved under the single 100-year storm event and 50-year–50-year consecutive storm scenario, respectively. The findings demonstrate the importance of considering storm sequencing and show the potential of strategically designed NBS to complement integrated flood-hazard management.

Keywords: *flood regulation services; HEC-HMS; HEC-RAS 2D; paddy-field storage; return period; storm sequencing*

WAT-110 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Sewage Sludge Biochar as a Functional Catalyst for Microbial Nitrogen and Sulphate Removal in Vertical Flow Constructed Wetlands

A. Pawaiya[1*] and S. Suthar[1]

[1]*School of Environment & Natural Resources, Doon University, Dehradun-248001, Uttarakhand, India*

**Corresponding author: ashita.phd@doonuniversity.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.50

Abstract

The sewage sludge biochar (SSB)-linked shifts in nitrogen and sulphur metabolism and microbial functioning in vertical flow constructed wetlands (VFCWs) are unclear. This study investigated SSB as a functional amendment to enhance nitrogen and sulphate (SO_4^{2-}) removal from domestic sewage in *Typha*-planted VFCWs. Three VFCWs: VFCW-I, only substratum, no plantation; VFCW-II, with plant and SSB (10% v/v); VFCW-III, with plant but without SSB, were operated for 90 days at a 3-day hydraulic retention time in triplicate (n=3). Results showed that VFCW (with SSB) exhibited a 16.4% increase in nitrification efficacy, with 86.75% ($p < 0.001$) and 40.57% ($p < 0.001$) removals of ammonium nitrogen (NH_4^+-N) and total inorganic nitrogen (TIN), respectively, compared with the control VFCW. VFCW (SSB) achieved 41.49% ($p > 0.05$) SO_4^{2-}, suggesting stable redox conditions maintained by plant–microbe interactions. Metagenomic analysis revealed a 34.2–37.77% increase in nitrification genes (e.g., amoA, nxrB), and 7.67–20.2% in DNRA genes (e.g., narG, napA, norB, nirB) and sulphur-cycle genes (e.g., soxX, soxA) in VFCW amended with SSB, consistent with enhanced nitrogen and sulphate removal through microbial transformations. Further, X-ray photoelectron spectroscopy (XPS) analysis of SSB sulphur-driven denitrification and metal-SO_4^{2-} precipitation revealed the prominent mechanisms for sulphur reduction. These findings show the synergistic pollutant removal and microbial mechanisms in VFCWs. The study suggests that SSB can be utilized as a sustainable carbon source in VFCWs to support effective microbial functioning, aligning with a circular engineering approach in wastewater treatment processes.

Keywords: *nature-based solutions; nitrogen removal; phytoremediation; sewage sludge biochar; sulphur metabolism*

WAT-115 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Assessment of Bacterial and Biochar Functionalization of Alginate-Coated Zinc Anodes for Bioelectrochemical Energy Generation in Wastewater

R. Nithya[1], V. Pavithra[1], P. G. Suriy[1] and S. Sivasankari[1*]

[1]*Microbial and Bioprospecting Bioenergy Laboratory, Department of Green Energy Technology, Madanjeet School of Green Energy Technologies, Pondicherry University, Puducherry, India*

**Corresponding author: sivasankari.get@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.51

Abstract

Wastewater treatment and simultaneous bioelectricity generation offer a sustainable approach for low-energy wastewater management. This study evaluated alginate-CaCl2 functionalized zinc anodes incorporating bacterial consortium (Hb-1 and Hb-2) isolated from Hibiscus leaves and paddy-straw derived bio-char in a single-chamber microbial fuel cell (MFC). Four anode configurations were investigated: sodium alginate-CaCl2 control (SA-CA), bacteria-functionalized (SA-CA-B), bio-char-functionalized (SA-CA-BC), and bacteria-bio-char functionalized (SA-CA-B-BC). Bacterial consortia wet biomass 0.05g was incorporated into the alginate-CaCl2 coat, while wastewater served as the substrate. The MFC was operated for 120 h. using zinc and copper electrodes (15× 5 cm; projected area 0.0075 m^2) with a 10 Ω external resistance. During the initial 48 h, the SA-CA-B configuration showed higher electrochemical performance; however, with the extended operation, the SA-CA-B-BC configuration progressively improved and demonstrated superior performance reaching 534 mV, 53.4 mA, 7120 mA m^{-2} and 3802.1 mW m^{-2} for voltage, current, current density and power density, respectively, at 96 h. At 120 h, it maintained 474 mV, 47.4 mA, 6320 mA m^{-2} and 2995.7 mW m^{-2}, respectively. The untreated wastewater pH was 7.25 and increased to 8.21 after operation, while initial dissolved oxygen was 3.33± 0.02 mg L^{-1}. Turbidity decreased from 0.077 ± 0.05 OD in intreated wastewater to 0.010 ± 0.04 in the SA-CA-B-BC treatment, corresponding to an approximately 87.0% reduction. Overall, combined bacterial and paddy-straw-bio-char functionalization supported sustained bio-electrochemical energy generation alongside substantial turbidity reduction, demonstrating potential for integrated wastewater treatment and energy recovery.

Keywords: *bio-char; bioelectricity generation; microbial fuel cell; wastewater; zinc–copper electrode*

WAT-126 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Green Synthesis of Copper Oxide Nanoparticles Using *Cyanthillium cinereum* as a Sustainable Photocatalyst for Wastewater Treatment

A. M. M. C. H. Jayawardene[1], M. Kandiah[1*], O. Perera [1], B. Gunaratne [1], D. Perera[1]

[1]*Department of Biomedical Sciences, Faculty of Life and Medical Sciences, BMS Campus, Colombo 00600, Sri Lanka*

**Corresponding author: chathumini.jayawardena@bms.ac.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.52

Abstract

The pollution of the aquatic ecosystem from synthetic dyes and toxic compounds released by industrial wastewater remains a crucial challenge to achieve sustainable water management. The study investigates the green synthesis of copper oxide nanoparticles (CuONPs) utilising aqueous extracts of the leaves, roots, flowers and stems of Cyanthillium cinereum, a Sri Lankan plant (Monarakudumbiya). Phytochemical analysis confirmed the presence of alkaloids, phenols and flavonoids, which serve as reducing and capping agents. Synthesis was optimised at 45°C for 15mins and nanoparticle synthesis was confirmed through UV-Vis surface plasmon resonance peaks between 240-280nm. Para-nitrophenol (PNP; 600 µM) degradation was performed under light with 0.1M $NaBH_4$ and 10-60µL of CuONPs, monitored using the microplate reader (280-580 nm) every 10mins for 1h. Methylene blue (MB) and methyl orange (MO) degradation was performed under sunlight for 1h by adding 0.1mL of CuONPs (3,200 or 32,000ppm) to 10mL of 20ppm dye, with and without 0.1mL of 0.1M $NaBH_4$, monitored using the microplate reader every 10mins. The synthesised CuONPs demonstrated strong photocatalytic activity against three pollutants; leaves CuONPs achieved the highest rate constant of 0.0339min-1 for PNP degradation, 0.1025min-1 for MB degradation at 3,200ppm with NaBH4, while the roots CuONPs achieved a rate constant of 0.0124min-1 for MO degradation at 32,000ppm with NaBH4. Cytotoxicity analysis using Artemia salina and Danio rerio showed 100% viability across all tested concentrations. Thus, these findings confirm that C. cinereum CuONPs are effective, low-cost, eco-friendly photocatalysts in the degradation of PNP, MB and MO, further supporting their application in green nanotechnology approaches to water resource management.

Keywords: *copper oxide nanoparticles; Cyanthillium cinereum; green synthesis; Monarakudumbiya; water resource management*

WAT-127 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

Eco-Friendly Synthesis of Copper Oxide Nanoparticles from *Oryza sativa* Rice Husk Extracts for Water Pollutant Treatment

S. K. Nadeem1*, M. Kandiah[1], O. Perera[1], B. Gunaratne[1] and D. Perera[1]

[1]*Faculty of Life and Medical Sciences, BMS Campus, Colombo, Sri Lanka*

**Corresponding author: saharnadeem458@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.53

Abstract

Non-degradable synthetic pollutants like azo dyes Methyl Orange (MO) and Methylene Blue (MB) released from textile effluents, and industrial chemicals like para-nitrophenol (PNP), threaten aquatic organisms, introducing the demand for low-cost, eco-friendly degradation methods. Rice husks (RHs), one of the largest underutilised agricultural wastes in Sri Lanka, can be valorised to meet this need. This study investigated eco-friendly synthesis of copper oxide nanoparticles (CuONPs) from RH extracts of five traditional Sri Lankan Oryza sativa varieties. Phytochemical analysis confirmed carbohydrates, flavonoids, phenols and tannins as capping and reducing agents, with nanoparticle synthesis optimised at 90°C for 2 hours. UV-Vis (255nm peak) and EDX confirmed the elemental composition of synthesised CuONPs. PNP catalytic degradation and MO and MB photocatalytic degradation were assessed separately across all five varieties, revealing over 30-fold variation in PNP rate constants. Kuruluthuda-derived CuONPs (KT_CuONPs) performed well across all three pollutants: PNP reduction was highest at 25 µL (0.1096 min^{-1}, R^2 0.97), MO degradation was highest at 2000 ppm (0.0045 min^{-1}, R^2 0.66), and MB degradation was highest at 2000 ppm (0.0039 min^{-1}, R^2 0.87), with Suwandal-derived CuONPs showing strong MB activity and the best model fit (R^2 0.99). Cytotoxicity analysis in Artemia salina and Danio rerio showed 100% viability across all tested concentrations, with no morphological abnormalities, indicating biocompatibility within these tested doses and organisms. Findings demonstrated that RH derived CuONPs are effective at degrading model water pollutants, supporting their potential as a low-cost, waste-derived tool for future sustainable water treatment applications, necessitating further economic and scale-up analysis.

Keywords: *copper oxide nanoparticles; green synthesis; Oryza sativa; photocatalytic degradation; rice husks; water resource management*

WAT-128 ORAL PRESENTATION · WATER TRACK · NATURE-BASED WATER SOLUTIONS

In vitro Green Synthesis of *Artocarpus altilis* Copper Oxide Nanoparticles: A Nano-Catalytic Approach in Wastewater Treatment

M. I. Ismail[1*], M. Kandiah[1], O. Perera[1], B. Gunaratne[1] and D. Perera[1]

[1]*Department of Biomedical Sciences, Faculty of Life and Medical Sciences, BMS Campus, Colombo 00600, Sri Lanka*

**Corresponding author: iesa.ismail@bms.ac.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.54

Abstract

In the industrial world, the pollution of water from toxic compounds and synthetic dyes remains a challenge to be resolved to achieve sustainable water management goals. This research was conducted to synthesis copper oxide nanoparticles (CuONPs) via a green, eco-friendly route using aqueous leaf, peel and bark extracts of Artocarpus altilis (breadfruit) also known as dell, a plant commonly found in Sri Lanka and other tropical regions. Optimal synthesis conditions of CuONPs was at 90°C for 2 hours. Phytochemical analysis confirmed the presence of flavonoids, tannins and alkaloids in the aqueous extracts, which act as reducing and capping agents in CuONP synthesis. Nanoparticle presence was confirmed by UV-Vis surface plasmon resonance peak at 580nm. Scanning Electron Microscopy revealed spherical 50nm Leaves_CuONPs. Zeta potential analysis presented a value of -34.1mV and PSA analysis revealed a value of 16.2nm for CuONPs synthesized from leaves_CuONPs. Para-Nitrophenol (PNP) catalysis took place instantly with the addition of synthesized bark, peel and leaves CuONPs. The best degradation with methyl orange (MO) was with Leaves_CuONP at 2400ppm and NaBH4 with a rate constant of 0.2643min-1. No degradation was observed with methylene blue (MB). Cytotoxicity of the nanoparticles was analyzed using Artemia salina and were observed to be 100% viable at concentrations of 5, 1 and 0.1ppm. These findings demonstrated that A. altilis-mediated CuONPs possess promising potential as catalysts in pollutant removal of PNP and MO with leaves CuONPs exhibiting the greatest performance while being used at lower concentrations to be a safe alternative method.

Keywords: *Artocarpus altilis; copper oxide nanoparticles; green synthesis; wastewater treatment*

WAT-25 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Delineation of Groundwater Potential Zones along the Kelavarapalli–Krishnagiri Reach, Tamil Nadu, Using an Integrated Multi-Influencing Factor, AHP, and Bivariate Statistical Framework

P. P. Sreenivasan[1], S. T. D. Ur Rahman[1], R. Gokul[1], S. Yuvraj[1] and V. Narayanamurthi[1*]

[1]*Department of Civil Engineering, Easwari Engineering College, India*

**Corresponding author: pamba1309pps@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.55

Abstract

Groundwater availability along the Thenpennai (South Pennar) River corridor between the Kelavarapalli and Krishnagiri reservoirs, Tamil Nadu, is strongly influenced by the region's hard-rock terrain, comprising charnockite, gneiss, and associated crystalline lithologies. Conventional groundwater potential zone (GWPZ) studies in comparable hard-rock regions commonly employ expert-based Analytic Hierarchy Process (AHP) pairwise comparisons, which may introduce subjectivity. Therefore, this study integrated the Multi-Influencing Factor (MIF) technique, AHP, and bivariate statistical analysis to delineate groundwater potential zones along the Kelavarapalli–Krishnagiri reach. Eight thematic factors, namely lithology, geomorphology, slope, drainage density, lineament density, soil texture, land use/land cover, and topographic wetness index, were analysed in a GIS environment. Chi-square analysis and Cramer's V were used to quantify dependencies among the thematic factors and support the AHP weighting process, while consistency was verified using the consistency ratio. The weighted thematic layers were integrated through weighted overlay analysis. The resulting groundwater potential map classified the study area into poor (32.80%), moderate (46.56%), good (22.88%), and very good (2.24%) potential zones. Validation using an independent well-yield dataset achieved an overall accuracy of 85%, indicating strong agreement between the mapped groundwater potential classes and field observations. The results demonstrate that statistically supported weighting can provide a more objective basis for groundwater potential mapping in hard-rock aquifer systems.

Keywords: *analytic hierarchy process; bivariate analysis; Cramer's V; groundwater potential zone; hard-rock aquifers; multi-influencing factor*

WAT-29 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Land Cover Controls on Thermal-Hydrological Stress: A Differential Evolution-Weighted Ecosystem Index Approach

J. B. A. Srimali[1,2*], H. G. L. N. Gunawardhana[1,2], T. M. N. Wijayaratna[1,2] and R. L. H. L. Rajapakse[1,2]

[1]1UNESCO-Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa 10400, Sri Lanka

[2]Department of Civil Engineering, University of Moratuwa, Katubedda 10400, Sri Lanka

*Corresponding author: srimaliano618f@gmail.com

DOI: https://doi.org/10.31705/ICEWSE.2026.56

Abstract

Composite ecosystem indices used in water resource and land management planning are typically built with subjectively assigned component weights, undermining their objectivity and cross-basin transferability. This study applies a Differential Evolution (DE) metaheuristic optimization algorithm to objectively derive weights for an Ecosystem Service Index (ESI), fusing InVEST-modelled Habitat Quality, Soil Retention, Normalized Difference Vegetation Index (NDVI), and Sentinel-1 SAR VH backscatter across the Giriulla sub-basin, Sri Lanka. The DE algorithm (50-individual population, 100 generations, 30 runs) was used to search for the weight vector that maximized the negative correlation between ESI and remotely sensed Land Surface Temperature (LST), reflecting vegetation- and soil-water-driven surface energy balance. Applied across three cloud-minimal years (2018, 2020, and 2024), the optimized index produced strong negative correlations with LST (Pearson r = -0.63 to -0.66; Spearman ρ = -0.70 to -0.72), with Soil Retention emerging as the dominant indicator (weight = 0.56). Forest patches sustained the coolest temperatures (25–40 °C) and maintained the highest ESI values, approaching 0.14, whereas urban environments and bare soils exhibited severe ecological suppression, with depressed ESI ranges of 0.08–0.09 and 0.10–0.11, and higher temperatures of 35–50 °C, reflecting land-cover-mediated water and energy exchange. Further, a protected forest reserve (Kegalle Kurulu Kele) recorded ESI of 0.120–0.135 and LST of 32–36 °C, consistent with this basin-wide intact-forest pattern. This remote sensing-based optimization framework offers landscape planners and ecosystem managers a scalable tool for identifying land-cover interventions that most effectively mitigate thermal and hydrological stress across data-scarce tropical basins.

Keywords: *differential evolution; land surface temperature; remote sensing; water-energy balance*

WAT-31 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Geospatial Assessment of Urban Flash Flood Risk and Vulnerability in Kolonnawa, Sri Lanka

W. R. S. Alwis[1*] and M. S. M. Razik[1]

[1]*Department of Geography, University of Peradeniya, Peradeniya, Sri Lanka*
**Corresponding author: randialwis6455@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.57

Abstract

Densely populated urban areas with poor and inadequate drainage infrastructure face acute exposure to high-intensity flash floods. This study employs geospatial techniques to assess flash flood hazards, vulnerability, and flood mitigation strategies across the Kolonnawa Divisional Secretariat Division (DSD), which has a population density of 8,219 persons/km^2. A flash flood hazard map was generated by integrating seven hydro-environmental factors: rainfall, elevation, slope, Topographic Wetness Index, soil type, land use/land cover, and distance to rivers. In parallel, an Urban Vulnerability Index (UVI) was developed separately by integrating data layers of population, building, and road network density. Data for the study were collected from both primary and secondary sources, including observations, interviews, OpenStreetMap (OSM), United States Geological Survey Data Portal, and Sentinel-2 satellite imagery. The Analytic Hierarchy Process (AHP) method was used to determine layer weights, and the flood risk map was generated by overlaying the hazard and vulnerability datasets. Spatial analysis indicates that nearly one-third of the Kolonnawa DSD falls within elevated risk zones, with 8.30% classified as very high risk and 20.74% as high risk for flash flooding. These zones are heavily concentrated in densely populated urban areas such as Wellampitiya, Angoda, Gothatuwa, Kolonnawa, and Orugodawatta. This spatial pattern highlights how unplanned urban growth, dense settlement patterns, and unsustainable land-use practices intensify flood vulnerabilities in low-lying urban areas. Therefore, prioritizing effective and comprehensive flood mitigation strategies is crucial for protecting socio-economic and environmental assets. Long-term, sustainable flood risk management will require a balanced integration of structural, non-structural, community-based, regulatory, and nature-based flood mitigation measures.

Keywords: *AHP; flash flood; hazard; mitigation; risk*

WAT-40 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Evaluating SMAP L4 Root-Zone Soil Moisture against Hydrologically Simulated Soil-Water States in the Upper Kelani River Basin, Sri Lanka

Y. A. D. K. H. Wijayarathna[1,2*], H. G. L. N. Gunawardhana[1,2], G. M. C. A. Perera[1,2], R. L. H. L. Rajapakse[1,2]

[1]*UNESCO-Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa 10400, Sri Lanka*

[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: wijayarathnayadkh.25@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.58

Abstract

Soil moisture regulates the conversion of monsoon rainfall into runoff, making it significant for flood forecasting. Satellite products such as the Soil Moisture Active Passive (SMAP) mission provide soil-moisture estimates but remain poorly evaluated in data-scarce tropical monsoon regions, particularly Sri Lanka. This study evaluates the consistency of SMAP L4 Version 7 root-zone soil moisture with soil-water states simulated by a discharge-calibrated Hydrologic Engineering Center–Hydrologic Modeling System (HEC-HMS) model of the upper Kelani River Basin above Hanwella (1,818 km^2). A continuous 11-subbasin HEC-HMS model used a 5 km grid, Gridded Deficit and Constant Loss, and SoilGrids-based Saxton and Rawls parameters. It was calibrated against daily discharge for 2020 and validated for 2021 (Nash–Sutcliffe 0.70, R 0.86, PBIAS −8%). Simulated soil-moisture deficit was converted to volumetric soil moisture and compared with 9 km SMAP using anomaly, day-to-day changes, lag, and flood-event analyses. Direct agreement between the two series was weak (R = 0.31; negative Nash–Sutcliffe), partly reflecting grid-scale mismatch between SMAP and HEC-HMS across steep terrain and canopy attenuation of retrievals under dense Wet Zone vegetation. Correspondence was stronger after removing the mean (R = 0.55) and for day-to-day changes (R = 0.39); the catchment-averaged series correlated at 0.58, increasing to 0.72 at a 17-day lag. Overall, SMAP captured aspects of sub-seasonal variability despite limited agreement in absolute magnitude, suggesting greater suitability for monitoring soil-moisture anomalies and wetness trends than directly updating HEC-HMS states in tropical basins.

Keywords: *antecedent soil wetness; data-scarce basins; flood and drought forecasting; remote sensing; tropical monsoon catchment*

WAT-55 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Satellite-Driven Aboveground Biomass Mapping and Its Hydrological Implications in Sri Lankan Tropical Catchments

K. H. T. Chamika[1,2*], B. C. Dissanayake[1,2], Chamal Perera[1,2] and R. L. H. L. Rajapakse[1,2]

[1]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*
[2]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: thushanch78@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.59

Abstract

Sri Lanka lacks a nationally consistent, locally validated aboveground biomass density (AGBD) map, while hydrological models still represent vegetation through land-cover classes. This study produced a locally validated 1 km AGBD map and tested whether biomass-based curve numbers outperform conventional land-cover-based values in rainfall-runoff simulation. GEDI Level 4B AGBD (2019–2021) was modelled from 20 predictors derived from MODIS, Sentinel-1, Sentinel-2, PALSAR-2, SRTM and CHIRPS with a zone-stratified spatial validation design. Held-out performance was r = 0.776 and MAE = 19.46 Mg ha^{-1}. Against 70 published field sites, r was 0.519 overall, 0.624 for natural forests and 0.745 for post-2015 sites, with underestimation at high biomass. Land-cover class explained only 2.3% of biomass variance, against 30.2% for annual rainfall. NDVI, EVI, LAI and FPAR saturated above 150 Mg ha^{-1}, their biomass correlations becoming negative. Within tree cover, biomass varied by 57.1% but the curve number (CN) by only 4.8%. Vegetation-adjusted CNs were therefore tested in HEC-HMS across nine catchments. Differences among conventional, biomass-, NDVI- and LAI-based fields were negligible: validation NSE differed by 0.008 and logNSE by 0.002. Catchment mean AGBD was strongly related to mean slope (r = 0.956), indicating close coupling of vegetation, terrain and climate that limits isolation of an independent vegetation effect. Satellite-derived biomass therefore captures vegetation structure that land-cover classes miss, but introducing it through CN adjustment did not materially improve hydrological simulation, indicating that alternative process representations are needed to capture vegetation–hydrology interactions.

Keywords: *aboveground biomass density; curve number; GEDI; hydrological modelling; remote sensing; vegetation–hydrology interactions*

WAT-63 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Spatial Quantification, Prioritization, and Comparing Soil Erosion risk across Agro-Ecological Zones in Werie Watershed, Northern Ethiopia: A RUSLE Model, GIS and Remote Sensing Approach

G. E. Haile[1*]

[1]*Mekelle University, Mekelle, Ethiopia*

**Corresponding author: guesh.endrias@mu.edu.et*

DOI: https://doi.org/10.31705/ICEWSE.2026.60

Abstract

Soil erosion by water is a critical environmental challenge in Ethiopia, particularly in the highlands, causing land degradation and reduced agricultural productivity. Localized assessments are needed for effective land management. This study quantifies soil loss, prioritizes hazard areas, and compares loss across agro-ecological zones in the Werie Watershed, Northern Ethiopia, using the Revised Universal Soil Loss Equation (RUSLE) and Geographic Information Systems (GIS). We integrated 31 years of rainfall for the Rainfall Erosivity (R) factor, soil data for Soil Erodibility (K), remotely sensed land cover for Cover Management (C), a Digital Elevation Model for Slope Length and Steepness (LS), and Support Practices (P) based on land use and slope. GIS processed and analyzed spatial data to generate a soil loss map. Mean annual soil loss was 9.73 t ha^{-1} yr^{-1} (0.09–436.37), showing high spatial variability. While 78.23% of the watershed experienced slight erosion (0.09–5 t ha^{-1} yr^{-1}), 10.65% was high to very extreme (>30 t ha^{-1} yr^{-1}). Comparison across Kolla, Weina Dega, and Dega zones showed distinct soil loss patterns. The Kolla zone had the highest average erosion (22.83 t ha^{-1} yr^{-1}), indicating high vulnerability despite smaller area. The Weina Dega zone, with moderate mean loss (8.77 t ha^{-1} yr^{-1}), contributed the largest total annual soil loss due to its size. The Dega zone exhibited the lowest mean rate (7.64 t ha^{-1} yr^{-1}). Given these findings, targeted soil and water conservation is urgently recommended, particularly in vulnerable lowlands and extensive mid-highlands, to promote sustainable management and mitigate erosion's adverse impacts.

Keywords: *erosivity; GIS; RUSLE; soil erosion; Werie watershed*

WAT-90 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Field-Deployable Smartphone Optical Metrology for Climate-Resilient Water Quality Surveillance

M. B. Chu[1*]

[1]*Ecotera Asia Pte Ltd, Singapore*

**Corresponding author: melinda@ecoteraasia.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.61

Abstract

Climate shocks degrade source and distributed water quality while interrupting laboratory logistics, so last-mile supplies and post-event triage often lack timely measurements. This study reports EcoExposure, a smartphone optical screening layer for climate-resilient water surveillance. Standardised low-volume sampling is read with a commodity camera under specified illumination and vessel geometry; adaptive scoring uses optical time-series rather than a single image. Field campaigns were completed in tap, rain, pond, river-adjacent, brackish, coastal and bottled waters in the United States, the Philippines, Singapore and the Seine/Epte basin. Across these matrices, non-specialist operators completed the structured assay when blanks, lighting, timing and avoidance of sampling plastics were specified; protocol discipline, not camera model, was the operational limit. Optical contrast was matrix-dependent, with high-turbidity and saline waters requiring adaptive endpoints. The platform is a screen-then-confirm tool: geotagged records can increase sampling density and route priority samples to accredited laboratories. It does not replace confirmatory chemistry or microbiology and does not claim polymer identification equivalent to Raman or FTIR; quantitative limits of detection, recovery and reference-method comparison are reserved for the full paper and for planned validation on Sri Lankan sources (Kelani, Mahaweli, coastal and groundwater). The work is intended as a complementary field layer for climate-disrupted water systems, aligned with existing monitoring cadres rather than a parallel workforce.

Keywords: *climate resilience; GIS; optical sensing; smartphone monitoring; water quality*

WAT-98 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

A Remote Sensing and Machine Learning Framework for Ungauged Reservoir Operation under Climate Change

S. V. Subasinghe[1*], G. M. C. A. Perera[1], R. M. J. Bamunawala[2] and R. L. H. L. Rajapakse[1]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa, Sri Lanka*

[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: subasinghesv.25@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.62

Abstract

The limited hydrological observations constrain reservoir management in data-scarce basins, particularly under changing climatic conditions. This study addresses this gap by developing an integrated framework for climate-adaptive reservoir operation in the Upper Malwathu River Basin, Sri Lanka. The Landsat imagery (1994–2024) and the Modified Normalized Difference Water Index (MNDWI) were used to derive reservoir extents, hydrological consistency, relative water depth, and temporal trends. Principal component analysis and hierarchical clustering classified 214 reservoirs into four classes with a silhouette coefficient of 0.353 and a Davies-Bouldin Index of 0.756. A HEC-HMS rainfall-runoff model estimated reservoir inflows with Nash-Sutcliffe efficiencies (NSE) and Root Mean Square Error (RMSE) of 0.47 and 0.7 for calibration, respectively, and 0.63 and 0.6 for validation. Particle swarm optimization generated physically feasible releases, and Long Short-Term Memory (LSTM) models learned release relationships at donor reservoirs for transfer to similar-class targets over 2010–2025. The donor model efficiencies were 0.789 for Manankattiya and 0.677 for Nachchaduwa. The transfer from Nachchaduwa to Nuwara Wewa was strong (NSE = 0.768, RMSE = 0.480), whereas transfer from Manankattiya to Thisa Wewa was weaker (0.417, 0.764), indicating that class membership alone does not ensure operational transferability. Furthermore, historically trained models preserved cumulative release volumes within 2.42% but produced low event-scale efficiencies of 0.177–0.215 under projected future conditions. Hence, re-optimizing releases using projected inflows and retraining models on updated releases are required to improve climate adaptability. This framework supports operational transfer to data-scarce reservoirs while demonstrating the need for local validation.

Keywords: *HEC-HMS; model transferability; remote sensing; reservoir classification; ungauged systems*

WAT-124 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Satellite-Based Assessment of Ditwah Cyclone Flood Impact and River Proximity Patterns Using Sentinel-1 and Rainfall Data

W. M. I. V. Wickramasinghe[1*] and G. R. L. Kodikara[1]

[1]*Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka*

**Corresponding author: wmivwickramasinghe@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.63

Abstract

Ditwah cyclone caused extensive flooding in Sri Lanka in late November and early December 2025, highlighting the need for rapid and spatially explicit assessment of flood impacts on vulnerable riverine environments. This study assesses the spatial characteristics of Ditwah induced flooding and post-event surface response within a selected flood prone section of the Kelani River Basin using satellite observations and rainfall data. Pre-event Sentinel-1 imagery acquired on 21 October 2025 and post-event imagery acquired on 8 December 2025 were analyzed together with an official satellite derived Ditwah flood extent and daily CHIRPS rainfall data. HydroRIVERS data was further used to quantify the spatial relationship between mapped flooding and river proximity. The mapped flood extent covered 8.511 km^2 of which 92.06% occurred within 1 km of rivers and 7.94% between 1 and 3 km, demonstrating a strong spatial concentration of flooding near river networks. Rainfall analysis identified 27 November 2025 as the day with the highest spatially averaged daily rainfall, reaching 7.63 mm day^{-1} across the study area. Sentinel-1 observations showed an 8.03% decrease in mean SAR intensity within the mapped flood footprint compared with a 7.70% decrease in non-flooded areas, indicating a slightly greater post-event SAR response within the flood-affected area, although the small difference suggests that the observed change cannot be attributed to flooding alone. The findings highlight flood concentration near rivers and the value of satellite-rainfall integration for rapid assessment. Future studies can use higher-resolution rainfall, hydrological and topographic data with multi-temporal Sentinel-1 imagery to better quantify flood dynamics and surface changes.

Keywords: *climate resilience; Ditwah cyclone; flood mapping; river proximity*

WAT-09 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Assessing Flood Attenuation Services and Hydrological Resilience of Wetland Environments in the Kelani River Basin, Sri Lanka

L. O. H. Perera[1] and E. J. Warusavitharana[1*]

[1]*Department of Town & Country Planning, Faculty of Architecture, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: emeshi@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.64

Abstract

Piecemeal wetland degradation can progressively weaken watershed flood regulation, yet cumulative and path-dependent hydrological responses remain poorly understood. This study assessed wetland flood-attenuation capacity and hydrological resilience in the Kelani River Basin, Sri Lanka, using a calibrated SWAT+ model. Natural marshes and paddy fields were explicitly represented as storage reservoirs within the watershed routing structure. The model simulated 2005-2024 hydrology at daily resolution, with monthly aggregation for calibration and validation; calibration (2015-2024) and validation (2007-2013) achieved NSE values of 0.75 and 0.53 and R^2 values of 0.946 and 0.878, respectively. A representative major flood was defined from the 2005-2024 simulated annual peaks using the Log-Pearson Type III method, corresponding to the May 2016 Cyclone Roanu event (>300 mm rainfall over three days). Under this event, existing wetlands provided approximately 1.3×10^8 m^3 of storage, while an annual retention deficit of 2.1×10^7 m^3 was identified. Fourteen progressive loss scenarios (5-90%) were generated by rule-based spatial prioritization of wetland conversion to built-up land, reflecting urban expansion patterns. Peak discharge increased nonlinearly with wetland loss (R^2=0.997), with acceleration emerging at 25-30% loss; at 90% loss, peak discharge increased by 109% and lag time decreased by 47%. Equivalent restoration scenarios exhibited a Hysteresis Index of 0.66, indicating that approximately 34% of lost flood-attenuation capacity could be recovered, while a Normalized Hysteresis Area Index of 47.4% indicated substantial cumulative hydrological impact. The findings demonstrate threshold behavior and hydrological memory, supporting basin-scale cumulative-impact assessment and prioritization of wetland conservation over reliance on proportional restoration.

Keywords: *complex adaptive system; flood attenuation; hysteresis; non-linearity; SWAT+; wetlands*

WAT-45 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Development of a Harmonized Long-Term Global River Discharge Database for Basin Water Resources Management

A. Senavirathne[1*], M. Leh[1], K. Matheswaran[1], P. T. Prabhath[1], N. M. Velpuri[1] and A. Seid[2]

[1]*International Water Management Institute, Colombo, Sri Lanka*
[2]*International Water Management Institute, Addis Ababa, Ethiopia*
**Corresponding author: a.senavirathna@cgiar.org*
DOI: https://doi.org/10.31705/ICEWSE.2026.65

Abstract

Reliable long-term river discharge observations are fundamental for understanding surface-water variability and supporting effective river-basin management, yet global streamflow records remain fragmented across national and international repositories. This study developed a global daily river discharge database covering the period 1800–2026. Data was harmonized using PostgreSQL for systematic data integration, preprocessing, and quality control. Station metadata and daily discharge observations were compiled from multiple hydrological databases through application programming interfaces, direct downloads, and request-based access. Spatial preprocessing removed stations with missing, invalid, or geographically erroneous coordinates. Stations sharing identical coordinates were identified as potential duplicates and evaluated using station names, record start and end dates, temporal overlap, common observation dates, and discharge-series similarity. The preprocessing workflow generated 20,209 pairwise comparisons, including 908 pairs with accessible discharge observations from both sources. Duplicate, continuation, and overlapping records were reconciled by retaining the most complete record or merging complementary observations after removing repeated dates. Overall, 18,393 source records were consolidated during harmonization. The final database contains 65,804 unique physical stations, including 50,806 stations (77.2%) with daily discharge observations and 14,998 metadata only stations (22.8%). The harmonized database provides a consistent foundation for global and basin scale assessments of streamflow, water availability, hydrological variability, flood and drought conditions, and long-term changes monitoring, supporting evidence-based water resource planning and sustainable river basin management.

Keywords: *data harmonization; global river discharge; long-term hydrology; PostgreSQL; river-basin management; streamflow database*

WAT-50 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Data Quality as Part of the Model Performance: Benchmarking Missing-Value Imputation for Tropical Streamflow Prediction

A. H. Z. Aqthaf[1*] and R. L. H. L. Rajapakse[1]

[1]*Department of Civil Engineering, Faculty of Engineering, University of Moratuwa, Katubedda, Sri Lanka*

**Corresponding author: aqthaf.hm@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.66

Abstract

Globally, reliable hydrological prediction depends not only on model architecture but also on how missing hydro-meteorological observations are reconstructed before model training. This issue is critical in data-scarce tropical basins, where missing rainfall, temperature, evaporation, and streamflow observations are common, and imputation methods are often selected by convention rather than by evidence. This research benchmarks twelve missing-value imputation methods across four Sri Lankan river basins, four variable classes, and five synthetic missingness levels (5–40%) generated as short (1–3-day) and occasional longer (20–30-day) dropouts mimicking sensor failure, yielding 960 completed method–basin–variable–missingness evaluations. The methods span linear interpolation, Kalman filtering, k-nearest neighbours, multiple imputation by chained equations, missForest, Gaussian-copula and gradient-boosted approaches, together with self-attention and bidirectional recurrent deep imputers. A Friedman test demonstrates significant performance differences among methods ($p<0.001$), with SAITS and BRITS achieving the strongest ranks. However, linear interpolation remains statistically competitive with several established methods, matches SAITS for streamflow reconstruction, and requires approximately 18,000 times less computation. Performance depends strongly on variable and basin characteristics; notably, an STL-plus-spline approach fails severely for bursty tropical rainfall. When reconstructed inputs are propagated through a downstream XGBoost streamflow model, the mean spread in validation Nash–Sutcliffe efficiency across imputation methods is only 0.091, while 74.5% of all method–basin–missingness combinations exceed NSE values of 0.80. These results show that imputation accuracy does not translate into proportionate gains in hydrological prediction. The study therefore proposes a performance- and application-based decision framework in which imputation sophistication is matched to downstream sensitivity, data characteristics, and computational constraints.

Keywords: *computational efficiency; decision framework; deep learning; gap-filling; hydrological time series; Sri Lankan river basins*

WAT-73 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Performance Evaluation of Global Ensemble Forecast System (GEFS) Based Reservoir Inflow Forecasting for Almatti Reservoir, India

S. Saravanan[1*], E. Arivoli[1,2], S. Joshi[2] and K. Chandrasekar[2]

[1]*Department of Civil Engineering, National Institute of Technology, Tiruchirappalli, India*
[2]*National Remote Sensing Centre, Indian Space Research Organisation, Hyderabad, India*
**Corresponding author: ssaravanan@nitt.edu*
DOI: https://doi.org/10.31705/ICEWSE.2026.67

Abstract

Accurate reservoir inflow forecasting is essential for effective reservoir operation and water resources management. This study evaluates the performance of the Global Ensemble Forecast System (GEFS) coupled with the Variable Infiltration Capacity (VIC) hydrological model for forecasting inflows to the Almatti Reservoir during a selected high-flow event from 15 to 30 June 2021. During the event, the observed reservoir inflow peaked at 4,390 m^3/s. Three inflow hydrographs were considered: observed reservoir inflow, VIC-simulated inflow using observed rainfall from the India Meteorological Department (IMD), and forecast inflow generated using GEFS rainfall. The GEFS–VIC forecasts were evaluated at a 3-day forecast lead time by comparing the forecast and observed inflows. Forecast deviation was quantified as the percentage difference between GEFS–VIC forecast and observed inflows, with positive and negative values indicating overestimation and underestimation, respectively. The results show substantial deviation during the initial forecast period, with an average deviation of about 243%. Forecast performance improved during subsequent periods, with average deviations reducing to −18% and −32%. The forecast errors also varied with the stage of the observed inflow hydrograph. Overall, the GEFS–VIC forecasts captured the general temporal pattern, including the rapid rising and subsequent recession phases, although underestimation was evident during several later forecast periods. Comparison with VIC simulations driven by observed IMD rainfall provides a reference for understanding the influence of rainfall forecast uncertainty. The results demonstrate the potential of the GEFS–VIC framework for short-range operational reservoir inflow forecasting and supporting reservoir management decisions.

Keywords: *Almatti reservoir; ensemble rainfall forecasting; GEFS; reservoir inflow forecasting; VIC model*

WAT-76 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Development of a National-Scale SMHI HYPE Model for Water Resources Assessment in Sri Lanka under Data-Scarce Conditions

K. Gangabadage[1]*, H. Amaguchi[1] and Y. Imamura[1]

[1]*Tokyo Metropolitan University, Japan*

**Corresponding author: gangabadage-pabasara@ed.tmu.ac.jp*

DOI: https://doi.org/10.31705/ICEWSE.2026.68

Abstract

Sri Lanka exhibits pronounced spatial and temporal variability in water availability, resulting in contrasting hydrological risks ranging from recurrent floods in wet regions to water scarcity in seasonally dry regions. National-scale hydrological assessment is therefore important for integrated water resources management; however, its application remain constrained by the limited spatial coverage, accessibility, and continuity of in-situ hydro-meteorological observations. Although globally available Earth observation and reanalysis datasets offer a potential alternative, their suitability for hydrological modelling under Sri Lanka's contrasting hydroclimatic conditions require systematic evaluation. This study develops a national-scale semi-distributed hydrological modelling framework for Sri Lanka using the process-based SMHI HYPE model, integrating publicly available JAXA GSMaP precipitation, ERA5 reanalysis temperature, and SMAP L4 root-zone soil moisture, with in-situ observed streamflow. A pilot application is conducted in the upstream Kelani River Basin, selected for its relatively greater availability of hydrological observations, to evaluate the modelling framework prior to its broader national-scale application. Model calibration incorporates streamflow and root-zone soil moisture through a multi-variable calibration approach using Monte Carlo simulations, while multi-source validation considers streamflow, soil moisture, and reservoir storage variations. Initial pilot basin model application identified the need for further evaluation and local bias correction of public hydro-meteorological datasets before robust model calibration and national-scale implementation. These results guide the ongoing refinement of the modelling framework towards its application in data-scarce and poorly gauged regions of Sri Lanka.

Keywords: *HYPE model; national-scale hydrological modelling; poorly gauged basins; public datasets; Sri Lanka*

WAT-78 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Development of a Modified SCS Curve Number Method to Estimate Runoff in Small Catchments in Sri Lanka

H. H. U. Manjitha[1*], G. M. C. A. Perera[1,2] and H. G. L. N. Gunawardhana[1,2]

[1]*Department of Civil Engineering, University of Moratuwa, Moratuwa, 10400, Sri Lanka*
[2]*UNESCO Madanjeet Singh Centre for South Asia Water Management, University of Moratuwa, Moratuwa, 10400, Sri Lanka*

**Corresponding author: manjithahhu.25@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.69

Abstract

The conventional SCS Curve Number (SCS-CN) method is the most widely used approach for runoff estimation in ungauged catchments, but its static, table-based parameterization poorly represents the dynamic runoff response of tropical catchments. This study develops a modified SCS-CN method for 10+ small catchments in the wet, intermediate, and dry zones of Sri Lanka by integrating causal discovery, structural equation modelling (SEM), physics-informed neural networks (PINNs), transfer learning, and uncertainty quantification within a single framework. Causal discovery first identifies the rainfall, soil, land-use, and catchment characteristics that drive runoff generation, and SEM quantifies their direct and combined effects, replacing the static tabulated curve number with a dynamic, catchment-specific CN function. This dynamic CN is then embedded as a physical constraint in a PINN trained on observed rainfall-runoff data, while transfer learning extends the calibrated framework to data-scarce catchments and uncertainty quantification provides prediction intervals for each runoff estimate. The framework is evaluated through split-sample testing and benchmarked against the standard SCS-CN method and conventional data-driven models using Nash-Sutcliffe efficiency (NSE), percent bias (PBIAS), and root-mean-square error (RMSE). By combining physically interpretable structure with data-driven adaptability, the modified method is designed to reduce the parameter uncertainty of the conventional approach and to provide reliability-quantified runoff estimates for water resources planning, flood design, and agricultural water management in ungauged tropical catchments.

Keywords: *causal discovery; physics-informed neural networks (PINN); rainfall-runoff modelling; SCS-CN method; transfer learning; tropical hydrology*

WAT-85 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Identifying Soil Erosion and Sediment Delivery Hotspots for Restoration Planning in the Upper Mahaweli Watershed, Sri Lanka

S. Dissanayaka[1*], N. Eriyagama[1], L. Muthuwatta[1], T. Gurusinha[1] and R. Jirasinha[1]

[1]*International Water Management Institute (IWMI), Colombo, Sri Lanka*

**Corresponding author: s.dissanayaka@cgiar.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.70

Abstract

Soil erosion and sediment delivery threaten reservoir storage, hydropower generation, irrigation reliability, and downstream water security in Sri Lanka's Upper Mahaweli Watershed. This study identified priority areas for restoration through a geographic information system (GIS)-based assessment of eight reservoir basins (Upper Kotmale, Kotmale, Polgolla, Victoria, Randenigala, Rantembe, Puhulpola, and Dyraaba). The Revised Universal Soil Loss Equation (RUSLE) and Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) Sediment Delivery Ratio (SDR) model estimated gross sheet and rill erosion and sediment export to streams, respectively. The land-use map updated after Cyclone Ditwah incorporated landslide-affected surfaces into hotspot screening. Rantembe had the highest mean gross soil loss and sediment export rates (62.3 and 18.2 t ha^{-1} yr^{-1}), closely followed by Randenigala (57.5 and 17.2 t ha^{-1} yr^{-1}). Upper Kotmale recorded the lowest rates (34.7 and 9.3 t ha^{-1} yr^{-1}), with Dyraaba recording the second-lowest rates. The remaining reservoir basins had intermediate sediment export rates. A multi-criteria assessment combining sediment export with flood exposure, drought exposure, landslide susceptibility, and forest degradation also ranked Rantembe highest in overall vulnerability, followed by Randenigala. Therefore, further detailed eco-hydrological assessments leading to the identification of targeted watershed management interventions will be conducted within the most vulnerable reservoir basins. The assessment, with potential for application in other watersheds, provides a screening approach for identifying erosion-prone areas exposed to broader climatic and environmental risks, enabling detailed investigations and restoration investments to be targeted towards priority areas.

Keywords: *InVEST SDR; Mahaweli watershed; restoration planning; RUSLE; sediment delivery; soil erosion; Upper*

DOI: https://doi.org/10.31705/ICEWSE.2026

WAT-101 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Assessment of Contaminants That Inhibit Aquatic Plant Growth in Lanka Pond

N. Wijesekera[1*], S. A. Witharana[1], S. Samaradiwakara[2] and R. Weerasooriya[1]

[1]*National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Royal Botanical Gardens, Peradeniya, Sri Lanka*
**Corresponding author: nalesha63@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.71

Abstract

The Lanka Pond is an ornamental freshwater pond located within the Royal Botanical Gardens, Peradeniya, Sri Lanka. The pond, once abundant in aquatic plants has recently exhibited widespread plant growth inhibition except in the uppermost "Jaffna region", despite repeated replanting. Water samples were collected from georeferenced sampling points arranged in a grid covering the pond, comprising 26 samples from vegetative and 19 from non-vegetative regions, to assess dissolved ionic constituents and nutrient availability potentially associated with aquatic plant-growth inhibition and to identify differences in water chemistry between the regions. Water quality was assessed by measuring physicochemical parameters, major cations (Na^+, K^+, Ca^{2+}, Mg^{2+}), anions (NO_3^-, PO_4^{3-}, F^-, Cl^-) and selected trace elements. The mean values of key physicochemical parameters in vegetative and non-vegetative regions were as pH 6.71 and 7.78, electrical conductivity (EC) 125.54 and 171.89 µS cm^{-1}, turbidity 6.08 and 1.22 NTU and alkalinity 37.90 and 169.75 mg L^{-1} as $CaCO_3$ respectively. Statistical analysis showed significant difference between water qualities of the regions by PERMANOVA test ($R^2 = 0.723$, $p = 0.001$). SIMPER analysis identified bicarbonate (HCO_3^-) (22.5%) and pH (21.4%) as the main contributors to the difference which are important parameters influencing aquatic plant growth. No clear chemical factor responsible for plant growth inhibition was identified as the measured parameters were generally within the recommended ranges, despite significant hydrochemical differences between the regions. Further investigations into organic matter, trace elements requiring highly sensitive analytical techniques and microbial communities are recommended to investigate the potential factors contributing to plant growth inhibition.

Keywords: *aquatic plants; inhibition; PERMANOVA; SIMPER; water quality*

WAT-105 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Planning of the Capacity Enhancement of Pahala Puliyankulama Tank: A Hydrological, Hydraulic and Environmental Assessment

D. M. T. P. Adikaram[1*], H. G. L. N. Gunawardhana[1] and R. L. H. L. Rajapakse[1]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: adikaramp7@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.72

Abstract

Small irrigation tanks in Sri Lanka's dry zone face variable rainfall and rising demand, where added storage improves dry-season availability but can inundate land and overload ageing structures. This study assessed the feasibility of enlarging Pahala Puliyankulama Tank, the uppermost reservoir of a cascade near the Wilpattu National Park buffer zone, by combining catchment hydrology, flood routing, downstream hydraulic design, and inundation assessment. The 26.7 km^2 catchment was delineated from a 30 m Shuttle Radar Topography Mission digital elevation model, and satellite imagery was classified into six land-cover classes (accuracy 75.3%, kappa 0.704). Forest cover (66.3%) and Hydrologic Soil Group D gave a composite curve number of 84. Rainfall records from two gauges were gap-filled using single and double-mass analysis. A 50-year design storm, following national minor-tank spillway practice, was derived by Weibull frequency analysis and routed through the Hydrologic Engineering Center's Hydrologic Modelling System (HEC-HMS), giving a peak inflow of 262.9 m^3/s. Raising the spillway crest and bund together by 0.5 m, so the added volume is usable, increased gross storage by 34.3% and attenuated the peak outflow by 25.6%, with about 2 m surcharge and 1 m freeboard; the higher operating head requires slope-stability, seepage, and energy-dissipation checks. Muskingum routing gave a downstream design discharge of 195.1 m^3/s, met by a four-cell reinforced concrete box culvert. About 12 ha of upstream land would be permanently submerged, requiring land-use verification, compensation and environmental-flow provision. The proposal is conditionally feasible, and the approach is transferable to other dry-zone cascades, where land cover, soil group, rainfall records, and proximity to protected areas govern the outcome.

Keywords: *dry zone irrigation; hydrological modelling; Pahala Puliyankulama Tank; storage capacity*

WAT-111 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Reservoir Capacity Enhancement of a Minor Tank in Dry-Zone Sri Lanka: A Case Study of Pahala Kegama Wewa

D. A. I. B. Silva[1*], H. G. L. N. Gunawardhana[1], R. L. H. L. Rajapakse[1], B. C. Dissanayake[1] and C. Perera[1]

[1]*UNESCO-Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: Isurunisilva2000@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.73

Abstract

Minor tanks in Sri Lanka's dry zone form cascade systems where storage decisions affect downstream water availability. This study assesses a proposed 0.5 m Full Supply Level increase at Pahala Kegama Wewa, Kala Oya basin. A 50-year design storm was developed from Gumbel frequency analysis of rainfall records (1995–2024, mean annual rainfall 1,242 mm) at Maradankadawela station, giving a 24-hour design rainfall of 168.23 mm and design inflow of 106.8 m^3/s using the Soil Conservation Service Curve Number (SCS-CN) loss method and unit hydrograph transform method, with Curve Number 76, derived from area-weighted land-use and soil mapping (Hydrologic Soil Group C) and lag time estimated from channel length, slope, and potential storage, in the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS). As observed discharge data were unavailable, calibration was not performed. Inflow was routed via a broad-crested spillway and outflow through a 1 km reach by the Muskingum method. The augmentation increases storage from 3.919 to 4.817 MCM (22.9%) and increases upstream inundation by 16.56 ha (171.90 to 188.46 ha) over agricultural land with resettlement implications, reducing peak spillway discharge from 32.1 to 29.5 m^3/s (8.1%). The routed discharge sized a downstream 2-cell box culvert (2.5 m × 2.0 m per cell) using Federal Highway Administration (FHWA) control methods, satisfying American Association of State Highway and Transportation Officials (AASHTO)/FHWA limits (headwater-to-culvert-height ratio, HW/D = 1.18). The cascade transfer effect reduces spill to downstream tanks, lowering irrigation for lower-cascade paddy farmers and requiring coordinated allocation. The project is technically sound and conditionally feasible, pending bund survey and institutional confirmation.

Keywords: *flood routing; HEC-HMS modelling; rainfall frequency analysis; reservoir augmentation; small tank irrigation systems; tank cascade hydrology*

WAT-129 ORAL PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Assessing Sustainability of the Lunugamwehera Reservoir in Sri Lanka

M. H. N. Nethmini[1] and N. K. Gunasekara[1,2*]

[1]*Department of Civil Engineering, University of Moratuwa, Katubedda, Sri Lanka*
[2]*Department of Civil Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*
**Corresponding author: nilupul.gunasekara@kdu.ac.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.74

Abstract

Growing water demand driven by population growth and agricultural expansion has increased concerns regarding the sustainable management of water resources. This study assesses the sustainability of the Lunugamwehera Reservoir in southern Sri Lanka, a major source of irrigation water for the region. HEC-HMS and an annual water balance (AWB) approach were used to estimate reservoir inflows, and assess storage variations during 2012–2023. Six sustainability indicators - annual water balance (AWB), storage variation (SV), spill efficiency (SE), domestic water demand satisfaction (DWDS), reservoir utilization (RU), and irrigation water demand satisfaction (IWDS) - were assigned relative weights using the Criteria Importance Through Intercriteria Correlation (CRITIC) method. The resulting weights were 0.202, 0.187, 0.186, 0.151, 0.150, and 0.124, respectively. The Sustainability Index (SI) was calculated annually using an additive aggregation approach and classified into five equal intervals within the 0.00–1.00 range, representing very poor, poor, moderate, good, and excellent sustainability levels. The results revealed considerable temporal variation in reservoir sustainability, with the highest SI recorded in 2012 (0.589), followed by declines to 0.379 in 2016 and 0.278 in 2020. Overall, the reservoir exhibited moderate sustainability during the study period, with SI ranging from poor to moderate sustainability. AWB, SV, and SE received the highest relative weights, indicating their greater contribution to the sustainability assessment. The findings highlight the importance of water balance, storage dynamics, and spill performance in reservoir management and provide a quantitative framework for assessing sustainability and evaluating management strategies.

Keywords: *annual water balance (AWB); inter-basin water transfer (IBWT); Kirindi Oya; optimized model parameters; Thanamalwila*

WAT-10 ORAL PRESENTATION · WATER TRACK · URBAN WATER & RESILIENT INFRASTRUCTURE

Hydrogeological Feasibility of Sponge Zone Implementation for Urban Flood Resilience and Groundwater Recharge in Bangalore

R. Aswathanarayana[1*] and R. Gopinath[1]

[1]*Department of Civil Engineering, BMS Institute of Technology and Management, Bengaluru, India*

**Corresponding author: aswath.raksha@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.75

Abstract

The present research scientifically assesses the feasibility of implementing sponge zones in Bengaluru as a nature-based water resource management strategy, to address shallow-aquifer depletion and flash flooding. The methodology encompasses conducting hydrological and hydrogeological investigations, around Bellandur - Varthur valley and Hebbal - Nagavara valley, considering a buffer zone of 2 kms on the either side of the valley, entailing field survey to locate and analyze urban drainage parameters, conduct well inventory, pumping - recovery tests, and gridded geophysical survey. Further, primary data mapping and its integration with Government based validated secondary data, explains the hydrogeological setup of the terrain. Well inventory analysis of 95 borewells in Bellandur Varthur wetland complex reveals a combination of pseudo aquifer conditions, due to continuous hydraulic loading over the weathered formations extending beyond 40 m, along with over-exploitation of ground water resource with water level fallen beyond 24 m, over the last 25 years. Similar analysis of 86 wells in Hebbal - Nagavara valley revealed that construction of basement structures, with excavation depth greater than the bed level of adjacent surface water bodies has developed hydraulic slopes, within the weathered formation and has led to hydrological imbalances. Also, as the seepages ingresses into the plot owing to the tangential flows, the degraded lake water, containing 95% of domestic sewage, saturates the phreatic aquifers with the contaminated water, slowly polluting the pristine ground water also. These afore-mentioned site-based scenarios limit the suitability for implementation of sponge zones. To summarize, Bengaluru's sponge-zone approach can rather be replaced with point recharge structures and inverted borehole mechanisms, designed site-specifically and positioned 2-3 m below the excavation depth of underground basement structures to account for local hydrogeological and drainage conditions, alongside urban-planning considerations.

Keywords: *groundwater recharge; hydrogeological assessment; nature-based water solutions; sponge zone; sustainable water management; urban flood resilience*

WAT-24 ORAL PRESENTATION · WATER TRACK · URBAN WATER & RESILIENT INFRASTRUCTURE

Enhancing Urban Stormwater Resilience through Surface Low Impact Development (LID) Measures: A Hydrological Assessment in Sri Lanka

M. E. Sutharsan[1*] and M. Shafique[1]

[1]*Brunel University of London, United Kingdom*

**Corresponding author: edsutharsan@yahoo.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.76

Abstract

Rapid urbanisation increases stormwater runoff. This study focuses on comparing four surface-based LID techniques, namely, bioretention cell, permeable pavement, rain garden, and vegetated swale, based on two hydrological performance measures, namely, infiltration efficiency and surface-runoff efficiency. The evaluation was carried out on a 2.5-acre mixed-land-use catchment in Vavuniya, Sri Lanka, that discharges into a lake. A model using the EPA Storm Water Management Model (SWMM) was created for 16 sub-catchments, 12 conduits, 12 junctions, and one outfall. The four surface LID measures were assessed relative to the baseline scenario, which represented the catchment without any LID measures. Rainfall was recorded over six hours, with a maximum intensity of 12 mm/h, and was categorised as a moderate rainfall event according to World Meteorological Organization criteria. The increase in infiltration for each LID measure was as follows: bioretention cell, 25%; permeable pavement, 33%; rain garden, 18%; and vegetated swale, 23%. Surface runoff was reduced by the following percentages for each LID measure: bioretention cell, 23%; permeable pavement, 23%; rain garden, 24%; and vegetated swale, 19%. Permeable pavement achieved the highest infiltration efficiency, while the rain garden achieved the highest surface-runoff efficiency. Although the differences in surface-runoff efficiency were small, the results suggest that the four measures have different hydrological efficiencies. The results show that permeable pavement could be selected over other surface LID measures where the priorities are infiltration and surface-runoff control. These results show that surface LID measures may be chosen purposefully to ensure resilience in urban planning and stormwater management. Consequently, urban planning should include a mix of surface LID measures, rather than just one, depending on the specific land use, available space, and dominant drainage objective in each case.

Keywords: *EPA SWMM; infiltration efficiency; Sri Lanka; surface green infrastructure; surface-runoff efficiency; urban stormwater management*

WAT-41 ORAL PRESENTATION · WATER TRACK · URBAN WATER & RESILIENT INFRASTRUCTURE

Johads as Resilient Urban Water Bodies: Reimagining the Climate Discourse in India

P. Kumar[1*]

[1]*Department of Political Science, University of Delhi, Delhi, India*

**Corresponding author: pkumar@polscience.du.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.77

Abstract

This paper examines the relationship between water and climate change by contextualising Johads (traditional water reservoirs) in the North Delhi district within the discourse on climate adaptation, mitigation, and resilience in India's National Capital. It argues that the water crisis cannot be addressed only through technological and infrastructural interventions, and that the revival of traditional water bodies and the knowledge systems associated with them is critical for building climate-resilient cities. The paper first discusses the growing importance of blue infrastructure in responding to climate change, particularly amid rising heat, flooding, water scarcity, groundwater depletion, and shifting rainfall patterns. It then examines the growing recognition of Indigenous Knowledge Systems and Practices in global climate governance and argues that India's climate politics have nevertheless continued to privilege particular knowledge systems and economic interests in water governance. The paper then focuses on Johads as socio-ecological structures that contribute to physical, psychological, social, cultural, and ecological well-being. Their restoration can support groundwater recharge, flood mitigation, urban heat reduction, and community well-being. Finally, the paper proposes three steps for protecting Johads: identification, demarcation, and notification. The paper also introduces geo-cultural mapping as a participatory approach that integrates GIS and remote sensing data with local knowledge and cultural practices. Methodologically, it is based on the use of digital humanities to map narratives and indigenous oral history to document knowledge. Using a comparative analysis between Holambi Kalan village in Delhi and Manipur village in Ahmedabad, the study demonstrates how geo-cultural mapping can help document and protect disappearing water bodies.

Keywords: *geo-cultural mapping; indigenous knowledge systems; johads; North Delhi*

WAT-130 ORAL PRESENTATION · WATER TRACK · URBAN WATER & RESILIENT INFRASTRUCTURE

Integrating Digital Technologies and Nature-Based Solutions for Climate-Resilient Urban Water Infrastructure Planning in African Cities: A Conceptual Framework

G. Laolang[1*] and N. X. Mashwama[1]

[1]*Iyunivesithi Walter Sisulu, Faculty of Engineering, Built Environment & Information Technology, Department of Built Environment, East London, South Africa*

**Corresponding author: glaolang@wsu.ac.za*

DOI: https://doi.org/10.31705/ICEWSE.2026.78

Abstract

African cities face escalating climate-related water challenges, including flooding, drought, water scarcity, ageing infrastructure and inadequate stormwater management, intensified by rapid urbanisation and constrained municipal capacity. The literature review identifies nature-based solutions (NbS) urban wetlands, green roofs, rain gardens and bioswales as increasingly documented options for African cities, nonetheless finds their institutionalisation restricted by poor land-use and infrastructure planning mandates, limited access to localised climate-risk data, weak technical capacity within municipal engineering departments, and constrained coordination across water, planning and environmental authorities. From the review analysis, the study found that digital technologies, particularly GIS-based spatial risk mapping, remote sensing, IoT-enabled monitoring and predictive analytics, emerge as key enablers for hazard visualisation, real-time infrastructure monitoring and evidence-based decision-making, though their uptake is constrained by limited digital infrastructure, data governance gaps and municipal skills shortages. Building on these findings, this paper proposes a conceptual framework comprising four interlinked components: (1) a climate-risk and vulnerability assessment layer mapping exposure of urban water systems using digital spatial tools; (2) an NbS infrastructure integration layer matching NbS typologies to context-specific risk profiles alongside conventional grey infrastructure; (3) a digital decision-support layer using monitoring and predictive analytics to guide adaptive infrastructure management; and (4) a governance and institutional-coordination layer aligning municipal, provincial and community stakeholders around shared data platforms. The framework contribution lies in positioning digital technologies as the connective mechanism that enables NbS and grey infrastructure to function as one adaptive system, rather than treating digitalisation and NbS as parallel interventions, as in much existing climate-resilient infrastructure literature. The study offers a conceptual, context-responsive basis for municipalities, planners and infrastructure practitioners in Africa to plan urban water systems capable of anticipating, withstanding and adapting to climate-related water risks.

Keywords: *Africa; climate adaption; digital transformation; infrastructure resilient; urban water management*

WAT-48 ORAL PRESENTATION · WATER TRACK · WATER GOVERNANCE & SOCIO-HYDROLOGY

Thermal Spring Governance in Arid Regions: Community Perspectives and Local Governance at Al Hammam, Oman

A. A. Hanai[1*], K. Alzeidi[1] and R. A. Habsi[2]

[1]*Center for Environmental Studies and Research (CESAR), Sultan Qaboos University, Al-Khod, Muscat, Oman*

[2]*Department of Soil, Water and Agricultural Engineering, College of Agricultural and Marine Sciences, Sultan Qaboos University, Al- Khod, Muscat, Oman*

**Corresponding author: aalhinai@squ.edu.om*

DOI: https://doi.org/10.31705/ICEWSE.2026.79

Abstract

Thermal springs are important yet understudied resources, particularly in arid regions. This study investigates community perceptions and management practices of Al Hammam Thermal Spring in Muscat, Oman's hottest geothermal spring (60–70°C). The spring has been managed as a typical Falaj, compromising its ecological integrity. A structured questionnaire survey of 60 residents in December 2025 assessed spring usage, governance perceptions, management satisfaction, and future development preferences. Findings emphasize the spring's importance to local livelihoods and rural identity, highlighting its diverse uses. Agriculture is the village's main economic activity, with flood irrigation widely used; however, adoption of modern irrigation methods remains limited, leading to inefficient water use. Respondents value the spring for its environmental, aesthetic, and therapeutic benefits, yet report dissatisfaction with government services, regulatory enforcement, and tourism management. Respondents notably rated community involvement in spring management highly, reflecting strong local stewardship. Most favor government-led tourism development and conservation-focused protection strategies over private-sector tourism development. These findings reveal governance gaps and community priorities but do not indicate environmental degradation, as the study did not directly assess hydrological or ecological conditions. The results support a more participatory governance model that enhances institutional collaboration and local engagement in monitoring and sustainable tourism planning. This model involves collective stewardship, equitable resource use, local monitoring, and shared decision-making, complementing traditional and government-led water management systems. Integrating community knowledge with systematic environmental monitoring strengthens the evidence base for balancing resource conservation, local livelihoods, and sustainable tourism at Al Hammam and other hot springs in arid regions.

Keywords: *Al Hammam thermal spring; arid regions; falaj irrigation; socio-economic value; sustainability; water governance*

DOI: https://doi.org/10.31705/ICEWSE.2026

WAT-72 ORAL PRESENTATION · WATER TRACK · WATER GOVERNANCE & SOCIO-HYDROLOGY

School-Based Citizen Science for Groundwater Awareness and Protection in the Jaffna Peninsula, Sri Lanka

D. S. E. Gamage[1*], L. Muthuwatta[1], N. Eriyagama[1], D. Malalgoda[1], M. Karthikeyan[1], S. Shanmuhananthan[1], P. Suvasthigha[1], T. Sounthararajah[1], M. Aheeyar[1] and R. Jirasinghe[1]

[1]*International Water Management Institute (IWMI), Battaramulla, Sri Lanka*

**Corresponding author: d.sithara@cgiar.org*

DOI: https://doi.org/10.31705/ICEWSE.2026.80

Abstract

Groundwater is the principal source of water in the Jaffna Peninsula, northern Sri Lanka. However, the resource faces increasing threats from seasonal salinity intrusion, over-extraction and urbanization, compounded by limited public awareness. This study aimed to assess the potential of a school-based citizen science programme to strengthen groundwater awareness, combining hands-on well-water salinity testing, student-led monitoring and creative activities to establish a network of student monitors championing groundwater conservation within their households and communities. Fifty-two schools were selected in coordination with the Department of Education, Northern Province. Students were trained in electrical conductivity (EC) monitoring using meters (Milwaukee EC59 testers) calibrated every six months against a standard reference solution, and 260 student scientists recorded weekly EC from household wells covering all five administrative zones (one well per household) over one year (2025–2026). The programme reached 4,583 students (2,085 girls, 2,498 boys) and reinforced engagement through quizzes, puzzles, posters, model and essay competitions, producing 298 posters, 28 models and 56 essays. Monitoring data captured seasonal and spatial variation in well-water EC declining from pre- to post-monsoon periods (Wilcoxon signed-rank test, $p<0.001$, $n=260$ wells). The largest decline occurred in Island zone, where EC decreased from 3,262 to 2,953 µS/cm (9.5%), with zone-specific variation (Kruskal–Wallis test, $p<0.001$). Student reflections indicated household-level discussions on reducing agricultural pumping and protecting recharge areas. These findings demonstrate the potential of school-based citizen science to strengthen groundwater awareness, establish a distributed monitoring network, and generate spatially and temporally resolved evidence to support sustainable groundwater management in the Jaffna Peninsula.

Keywords: *citizen science; groundwater management; Jaffna Peninsula; salinity monitoring; school-based education*

WAT-125 ORAL PRESENTATION · WATER TRACK · WATER GOVERNANCE & SOCIO-HYDROLOGY

Integration of Climate-Informed Flood Hazard Modelling and Community Perceptions for Adaptive Flood Risk Management in the Maha Oya River Basin, Sri Lanka

J. Vithurshika[1,2*] and G. M. C. A. Perera[1,3]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management, University of Moratuwa, Moratuwa 10400, Sri Lanka*

[2]*Department of Civil Engineering, University of Jaffna, Kilinochchi 42400, Sri Lanka*

[3]*Department of Civil Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: vithurshijeya96@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.81

Abstract

The Maha Oya River Basin (MORB) in Sri Lanka experiences recurring floods threatening more than one million residents. However, flood management has traditionally focused on physical hazard assessment, with limited integration of climate projections and community perceptions. This study develops a climate-informed flood risk framework integrating hydrological and hydrodynamic modelling with exposure, vulnerability, and community risk perception. Historical rainfall records from four stations were quality-controlled, and bias-corrected CNRM-CM6-1-HR projections under SSP1-2.6 and SSP5-8.5 were used to develop 50-year design storms using Gumbel frequency analysis and intensity-duration-frequency relationships. HEC-HMS 4.13 and 2D HEC-RAS 6.6 generated historical and future flood hazard maps, achieving an accuracy of 0.92 and bias score of 0.99 for calibration against the May 2016 flood, and 0.83 and 1.42 for validation against the November 2025 flood. Based on a sensitivity-tested tolerance of ±0.0001, increased-risk areas covered 19.74% and 18.30% of the basin under SSP1-2.6 and SSP5-8.5, while decreased-risk areas covered 4.17% and 8.74%, respectively, indicating spatially heterogeneous shifts in relative flood risk. Based on the flood-depth maps, six flood-prone GN divisions in Pannala and Divulapitiya were identified, and 40 households within mapped inundation zones were purposively surveyed. Results revealed low baseline trust in government agencies; after exposure to hazard maps, 87.5% reported improved understanding, 85% increased concern about future flooding, and 70% greater willingness to take protective action. These findings highlight the value of hazard-map-based risk communication and identify community perception integration into the flood-risk model as a key direction for future adaptive flood-risk management in MORB.

Keywords: *climate change; community risk perception; flood risk assessment; hazard-exposure-vulnerability; HEC-RAS; Maha Oya river basin*

SECTION

04

Oral Presentations: Energy Track

Contributed research on renewable and clean energy technologies, storage, materials and sustainable energy systems.

THEMES

- Advanced Energy Materials
- Artificial Intelligence for Renewable Energy
- Circular Economy and Sustainability
- Emerging Energy Technologies
- Energy Storage Technologies
- Green Buildings and Cities
- Green Energy and Sustainable Development
- Green Hydrogen and Fuel Cells
- Hydropower
- Renewable Energy Technologies

EN-51 ORAL PRESENTATION · ENERGY TRACK · ADVANCED ENERGY MATERIALS

Powering the Sustainable AI Future: Frugal Intelligence, Sustainable Energy, and Lifecycle Accounting at the Energy–Water Nexus

R. A. Prasath[1] and R. Sivasubramaniam[2*]

[1]*Laboratory for Energy Materials and Sustainability, Department of Green Energy Technology, Madanjeet Singh School of Green Energy Technologies, Pondicherry University, Puducherry, India*
[2]*Independent Researcher, Mysuru, Karnataka, India*
**Corresponding author: rasivasu@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.82

Abstract

The rapid expansion of artificial intelligence is creating a complex energy–water nexus, with interconnected demands arising from computation to cooling in the data center, electricity generation, semiconductor manufacturing, and the wider infrastructure and supply chains supporting AI systems. This work examines how AI can reduce both electricity and water use while maintaining performance and reliability. The framework covers ways to reduce demand through efficient AI models, algorithms, hardware, data center operations, cooling, water use, green and clean electricity, and smart workload placement. The framework considers energy and water use, carbon emissions, and water scarcity separately, recognizing that improving one may not always improve the others. Computational efficiency can reduce electricity demand and associated cooling requirements, but its water benefits depend on cooling technology, operating conditions and electricity supply. Dry cooling can reduce direct evaporation while increasing electricity-related impacts; alternative water sources can reduce potable water demand without necessarily reducing overall consumption. The use of low-carbon energy resources is essential for developing sustainable AI data centers, but their effectiveness depends on resource availability, additionality, temporal matching, and local grid conditions. A quality-constrained assessment is proposed using facility- and task-level indicators, geographically resolved water accounting, lifecycle boundaries and demand-rebound analysis. Sustainable AI is framed as the coordinated reduction of energy and water demands and their environmental consequences, rather than optimization of isolated efficiency ratios. Ultimately, sustainable AI requires a systems-level approach that combines frugal intelligence, efficient infrastructure, sustainable energy, and lifecycle accountability to deliver high-quality AI services with lower energy, carbon, water and environmental impacts.

Keywords: *AI cooling systems; artificial intelligence; data center; frugal AI; sustainable AI; sustainable energy*

EN-52 ORAL PRESENTATION · ENERGY TRACK · ADVANCED ENERGY MATERIALS

Hierarchical Design of Heterojunction Photocatalysts for Efficient Solar Hydrogen Production

S. Pandey[1], M. D. Dhileepan[2], S. K. Lakhera[2], B. Neppolian[3] and R. A. Prasath[1*]

[1]*Laboratory for Energy Materials and Sustainability, Department of Green Energy Technologies, Madanjeet School of Green Energy Technologies, Pondicherry University, Kalapet, Puducherry, India*
[2]*Department of Physics and Nanotechnology, College of Engineering and Technology SRM Institute of Science and Technology, Kattankulathur, Chennai, Tamil Nadu, India*
[3]*Department of Chemistry, SRM Institute of Science and Technology, Kattankulathur, Chennai, 603203, Tamil Nadu, India*
**Corresponding author: raprasath@pondiuni.ac.in*
DOI: https://doi.org/10.31705/ICEWSE.2026.83

Abstract

The semiconductor photocatalysis is a promising approach for sustainable solar-to-hydrogen energy conversion. However, the practical use of semiconductor photocatalysts is usually hampered by poor light utilization, rapid charge-carrier recombination, and slow surface redox kinetics. Hierarchical design of heterojunction photocatalysts is an effective strategy to overcome these limitations by combining complementary semiconductor components and functional cocatalysts to enhance light absorption, charge separation, and surface catalytic activity. We report the design and synthesis of a hierarchical Ag@g-C3N4/Cu_xO-BiOCl heterojunction photocatalyst for efficient solar hydrogen production. The photocatalyst is a Cu_xO-mediated g-C3N4/BiOCl composite for direct Z-scheme charge transfer with Ag nanoparticles as cocatalyst for proton reduction. The synergistic interaction among the heterojunction components promotes efficient charge separation while preserving strong redox capability. Consequently, the optimized photocatalyst achieved a hydrogen evolution rate of 175 μmol h-1 g-1, representing a 14-fold enhancement compared with pristine g-C3N4. These results show that the hierarchical engineering of photocatalyst heterojunctions significantly improves the performance of multicomponent photocatalysts for efficient solar-to-hydrogen energy conversion.

Keywords: *carbon nitride; green hydrogen; heterojunction; semiconductor photocatalysts*

EN-53 ORAL PRESENTATION · ENERGY TRACK · ADVANCED ENERGY MATERIALS

Single-Mg-Doped, Organic Molecule Engineered g-C_3N_4 for Photoelectrocatalytic Coupled Phenol Degradation with Water Splitting

M. Premkumar[1*], E. Pramila[1] and D. S. Sharada[1]

[1]*Molecular Engineering and Catalysis Laboratory, Department of Green Energy Technology, Madanjeet School of Green Energy Technologies, Pondicherry University, Puducherry, India*

**Corresponding author: premmahadev07@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.84

Abstract

The simultaneous production of renewable hydrogen and remediation of the environment through visible light is still a major challenge in photocatalysis. Graphitic carbon nitride (g-C_3N_4) is a semiconductor that is capable of absorbing light in the visible range and has a high electron–hole recombination rate, limiting its photocatalytic activity. This work investigates single Mg doping and organic-molecule modification of g-C_3N_4 for molecular engineering to enhance the charge separation and to achieve coupled phenol degradation and water splitting. The Mg doped g-C_3N_4 photocatalyst was prepared by thermal polymerization method, and then the surface electronic structure was modified by functionalizing with organic molecules. The FTIR, UV–visible diffuse reflectance spectroscopy, photoluminescence and electrochemical characterization of the synthesized materials was performed systematically to study their structural, optical and charge-transfer properties. The multifunctional photocatalytic performance was assessed by visible-light photocatalytic experiments with phenol as a model pollutant with water splitting. The optical and electronic properties of g-C_3N_4 were modified by the incorporation of Mg and then by the enrichment with the organic molecule, which led to better properties in the visible light range, as well as better interfacial charge-transfer properties. The modified photocatalyst showed higher photocatalytic efficiency towards the degradation of phenol and hydrogen evolution than the pristine g-C_3N_4. This synergistic effect is believed to be due to the electronic modulation effect of Mg and the oxidation and reduction effect of the organic molecules in the process of surface charge transfer, leading to efficient separation of the photocurrent and the oxidation and reduction reactions. Overall, the multifunctional properties of the engineered Mg-doped g-C_3N_4 are demonstrated by the combination of structural, optical, band-gap and photocatalytic results, showing that g-C_3N_4 can be considered a candidate material for environmental remediation and sustainable hydrogen-energy generation applications.

Keywords: *graphitic carbon nitride (g-C_3N_4); magnesium doping; molecular engineering; organic-molecule modification; phenol degradation; water splitting*

DOI: https://doi.org/10.31705/ICEWSE.2026

EN-56 ORAL PRESENTATION · ENERGY TRACK · ADVANCED ENERGY MATERIALS

Development of LDH-MOF-5-Based Tunable Active Sites of Metal Nodes (Mo|Mn|Sn|Ag) for the Efficient Transesterification of *Picochlorum oklahomense* Lipids for Biodiesel Production

Mrinal[1] and K. K. Jaiswal[1*]

[1]*Bioprocess Engineering Laboratory, Department of Green Energy Technology, Pondicherry University, Puducherry, India*

**Corresponding author: kkjindia.get@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.85

Abstract

The structural properties of metal-organic frameworks (MOFs) enhance the catalytic activity of the metal centers, which interact effectively with lipid molecules during transesterification. In this research, sustainable LDH-MOFs with tunable active sites at the metal nodes (Mo|Mn|Sn|Ag) were synthesized using terephthalic acid as the organic ligand and Zn-Co LDH. XRD revealed the presence of dominant, highly crystalline phases that preserved MOF structures. UV-visible spectra showed ligand-to-metal charge transfer accompanied by weak d-d transitions at the metal centers. FE-SEM micrographs revealed micro-flower, needles, and flake-like structures in the MOFs. The optimized conditions were employed to investigate the catalytic performance of the prepared MOFs in the transesterification of *Picochlorum oklahomense* lipids. Biodiesel conversion efficiencies are to be 89.2% (MOF-BL-Mo), 88.0% (MOF-BL-Mn), 80.0% (MOF-BL-Sn), 73.7% (MOF-BL-Ag), and 60.0% (pristine LDH), with major composition of FAMEs of palmitic acid (C16:0) and oleic acid (C18:1). The enhanced activity could be attributed to the synergistic effect of the MOF's porous structure, the Zn-Co LDH layers, and the catalytically active sites at the metal nodes, which enable stronger interactions between the catalyst and the lipid molecules. Therefore, the key findings demonstrate the potential of LDH-MOFs with green metal nodes as effective heterogeneous catalysts for the sustainable, high-yield production of microalgal biodiesel.

Keywords: *FAMEs; LDH-MOFs catalysts; microalgal lipids; Picochlorum oklahomense; transesterification*

EN-12 ORAL PRESENTATION · ENERGY TRACK · ARTIFICIAL INTELLIGENCE FOR RENEWABLE ENERGY

Predictive AI and Reinforcement Learning for Autonomous Microgrid Energy Management in Rural Areas

A. Sharma[1], J. Petau[1], Ravikiran[2*], R. Jayaramu[2], G. H. Klepp[1] and S. Shamsundar[2]

[1]*Fachbereich Informatik und Automation, Technische Hochschule Ostwestfalen-Lippe (TH OWL), Lemgo, Germany*
[2]*NIE-CREST, The National Institute of Engineering, Mysuru, Karnataka, India*
**Corresponding author: nayak.ravikiran@nie.ac.in*
DOI: https://doi.org/10.31705/ICEWSE.2026.86

Abstract

Rural microgrids incorporating solar, wind, and battery storage frequently rely on rigid, rule-based edge controllers for energy distribution. These static IF/THEN systems react only to immediate electrical states and fail to anticipate upcoming meteorological changes, leading to suboptimal energy routing and accelerated battery degradation. This paper proposes a novel machine learning architecture to replace conventional reactive logic with a predictive and autonomous energy management system. By extracting and merging historical minute-resolution telemetry logs from baseline microgrid hardware installed at Mysuru, India, with synchronized retroactive satellite weather data (e.g., NASA POWER), a comprehensive training dataset is established. A deep learning sequence model, utilizing architectures such as LSTM or Transformer, is developed to accurately forecast short-term renewable generation and local power demand. Simultaneously, a Reinforcement Learning (RL) agent, employing Proximal Policy Optimization (PPO), is trained in a custom virtual environment to act as an autonomous energy router. Deployed on a localized edge device (Raspberry Pi) communicating via an MQTT broker, the system dynamically optimizes power distribution in real-time through GPIO control signals. This predictive AI system aims to maximize renewable energy efficiency, offering a scalable blueprint for resilient off-grid rural communities.

Keywords: *autonomous microgrids; deep learning; energy management system (EMS); predictive AI; reinforcement learning; rural electrification*

EN-15 ORAL PRESENTATION · ENERGY TRACK · CIRCULAR ECONOMY AND SUSTAINABILITY

Microstructural Changes during Regeneration of Plaster of Paris Using Discarded Moulds

K. N. P. Thilakarathne[1*], B. P. T. Rukmal[1], T. A. M. P. Ariyaratne[1] and B. A. Karunaratne[1]

[1]*Department of Materials Technology, Faculty of Technology, Rajarata University of Sri Lanka, Mihintale, Sri Lanka*

**Corresponding author: niranjalapushparani@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.87

Abstract

Recycling discarded plaster of Paris (POP) molds has gained increasing importance due to environmental concerns and the need for sustainable utilization of gypsum resources. Previous studies have primarily focused on the recycling methods and improvements in macroscopic properties. This study examines the generation of spent POP molds, emphasizing microstructural changes induced by controlled thermal treatment followed by mechanical reprocessing to obtain regenerated calcium sulfate hemihydrate. The elemental composition of commercial and recycled POP was analyzed using Energy Dispersive X-ray Spectroscopy (EDX). Particle size distribution was evaluated using sieve analysis and laser-based particle size measurement techniques. Mechanical performance was assessed through compressive and flexural strength tests conducted using a Universal Testing Machine (UTM). Micro-structural characteristics, crystal morphology associated with β-calcium sulfate hemihydrate, were examined using Scanning Electron Microscopy (SEM). Functional properties were evaluated through water absorption tests, determination of moisture content using a moisture analyzer, and assessment of setting behavior, setting kinetics were characterized by monitoring temperature evolution during hydration, with maximum exothermic temperature serving as an indicator of material reactivity. Microstructural investigations revealed that mainly irregular-shaped particles were present in the used molds, while the treated material contains elongated particles. Investigations revealed that the micro-structural characteristics and physical and chemical properties of the resulting product confirmed the standard requirements of commercial-grade Plaster of Paris and complied with the specifications, despite a minor reduction in mechanical strength.

Keywords: *discarded molds; microstructure; morphology; plaster of Paris; regeneration*

EN-20 ORAL PRESENTATION · ENERGY TRACK · CIRCULAR ECONOMY AND SUSTAINABILITY

Advantages of Integrating Circular Economy Concepts in Promoting Sustainable Construction

C. V. Rajasekara[1*], U. M. S. Samararathne[1] and W. N. Kawmudi[2]

[1]*Department of Quantity Surveying, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*
[2]*Department of Design Studies, NSBM Green University, Homagama, Sri Lanka*
**Corresponding author: vishakarajasekara307@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.88

Abstract

Greenhouse gas emissions, trash production, and resource use are all heavily influenced by the building sector. Ecosystem degradation and increased demand for natural resources are driven by the conventional linear "take-make-dispose" approach. As a result, incorporating Circular Economy (CE) principles provides a sustainable substitute that prioritizes material reduction, resource efficiency, reuse, recycling, and the extension of material lifecycles. With a particular focus on the environmental, economic, and social dimensions of the Sri Lankan construction industry, this study investigates the benefits of implementing CE principles for promoting sustainable construction. To get information on this integration, a questionnaire survey was given to professionals in the field, such as contractors, consultants, quantity surveyors, engineers, architects, project managers, and other stakeholders. A total of 111 valid responses were obtained from a total of 120 surveys. The Relative Importance Index (RII) was used to rank the benefits of adopting Circular Economy practices, which were found to have significant positive effects on the environment, the economy, and society. In terms of the environment, cutting greenhouse gas emissions associated with transportation, manufacturing, and material extraction had the highest RII value of 0.782. With an RII rating of 0.764, maximizing resource efficiency for cost reduction was ranked highest economically. The greatest social benefit was found to be the encouragement of fair access to resources and careful resource management. The results show that by reducing environmental effects, maximizing resources and economic efficiency, and promoting social sustainability, Circular Economy principles greatly improve sustainable construction. Raising awareness, working together, and putting these ideas into practice are crucial to helping Sri Lanka's construction sector shift to a more sustainable and resource-efficient model.

Keywords: *circular economy; construction industry; energy efficiency; material reuse; sustainability; waste minimization*

EN-40 ORAL PRESENTATION · ENERGY TRACK · CIRCULAR ECONOMY AND SUSTAINABILITY

Footprint and Resource Decoupling in South Asian Economies: A Panel Data Approach

H. M. L. Abeyrathne[1*]

[1]*Department of Business Economics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*

**Corresponding author: hmlakmaliabeyrathne@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.89

Abstract

The continuous economic growth that South Asia has experienced during the last three decades has been characterized by urbanization, industrial sector expansion, and increased material extraction and consumption, but there have been doubts over whether the development strategy adopted by this part of the world is sustainable in the long run, while empirical studies on resource decoupling in South Asian economies have been few, with most existing studies focused on high-income OECD contexts. This paper attempts to fill that void by analysing the level and determinants of resource decoupling in SAARC countries from the period of 1995 to 2025 using the panel data approach where the material footprint per capita, obtained from the UNEP Global Material Flows Database, serves as the dependent variable, while GDP per capita and its square, industrial value added, trade openness, and governance quality (World Governance Indicators) serve as the independent variables driven from the World Development Indicators. Fixed effect panel regression analysis, which is confirmed by the Hausman test, was performed to address the presence of unobserved country heterogeneity; decoupling status was determined based on the growth elasticity of material footprint. Based on the results, it is clear that most economies in South Asia display relative and not absolute decoupling, where good institutional quality is related to higher success, industrialization with resource-intensive approach correlates with poor results, and openness of economies in terms of trade has been revealed to have a mixed influence. These results imply that institutional capacity and structure, not growth by itself, determine the speed of decoupling, providing insights for policymakers regarding fiscal, institutional, and regulatory structures to achieve resource-efficient and circular growth.

Keywords: *circular economy; governance quality; material footprint; panel data; resource decoupling; South Asia*

EN-43 ORAL PRESENTATION · ENERGY TRACK · CIRCULAR ECONOMY AND SUSTAINABILITY

Sustainability and Resilience-Based Framework for Waste-Derived Microgrids

A. Deepak[1*] and A. Kumar[1]

[1]*Department of Mechanical Engineering, Motilal Nehru National Institute of Technology Allahabad, Prayagraj, India*

**Corresponding author: anudeepak@mnnit.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.90

Abstract

India faces interconnected challenges of increasing waste generation, agricultural-residue burning, and unreliable electricity access, particularly in rural and peri-urban communities. Waste-derived microgrids can address these challenges by converting locally available biomass and organic waste into decentralized electricity. However, existing assessments often emphasize techno-economic performance while overlooking environmental impacts, social consequences, feedstock-seasonality risks, and resilience. This study conceptualizes a Waste-Biomass Microgrid Sustainability and Resilience Index (WBMSRI) for evaluating waste-derived microgrids in the Indian context. The proposed framework integrates technical, economic, environmental, social life-cycle, and resilience dimensions. It considers alternative conversion pathways, including anaerobic digestion, biomass gasification, and combustion, coupled with photovoltaic generation, battery storage, and backup systems. Key indicators include renewable-energy fraction, energy not served, levelized cost of electricity, net present cost, greenhouse-gas emissions, avoided open burning, occupational safety, local employment, energy affordability, community acceptance, and critical-load supply. Indicators are normalized and aggregated using multi-criteria weighting, while sensitivity analysis evaluates the influence of feedstock availability, technology selection, economic assumptions, and indicator weights. The framework is expected to demonstrate that the most suitable configuration is not necessarily the least-cost option, but one that balances reliable waste supply, affordable electricity, environmental benefits, social equity, and operational resilience. The proposed WBMSRI can support technology comparison and planning of circular, inclusive, and resilient decentralized energy systems in India.

Keywords: *electricity generation; index; microgrids; rural system; sustainability*

DOI: https://doi.org/10.31705/ICEWSE.2026

EN-06 ORAL PRESENTATION · ENERGY TRACK · EMERGING ENERGY TECHNOLOGIES

Development of an Energy Consumption Prediction Model for University Buildings

V. C. Jayalath[1*], S. M. Pathirana[1] and S. O. Dilshan[1]

[1]*Department of Applied Computing, Faculty of Computing and Technology, University of Kelaniya, Kelaniya, Sri Lanka*

**Corresponding author: vishwajachandimal@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.91

Abstract

Energy use in university buildings is a growing cost and sustainability concern, yet Sri Lankan universities lack tools to anticipate monthly consumption and act before it peaks. This study is an approach to developing an Energy Consumption Prediction Model for Sri Lankan University Buildings. As a sustainable approach, a prediction model can be used to predict the energy consumption for a period of time, in this case, a month. Preventive measures can be taken to address and prevent it from reaching that predicted amount. To achieve this goal, a machine learning system was developed along with a dataset. The dataset was created based on data collected from a questionnaire survey conducted at the Faculty of Computing and Technology, University of Kelaniya, and processed through energy modelling and related calculations to be unbiased with variations. A feedforward neural network model was the approach taken to construct the prediction model. The accuracy of the dataset was proven to be above 90% at K-number testing, while the prediction model, even though operational, was not validated by a comparison to actual data due to unavailability of data at the time of publication.

Keywords: *energy consumption prediction; energy modelling; feedforward neural network; machine learning; university buildings*

EN-14 ORAL PRESENTATION · ENERGY TRACK · ENERGY STORAGE TECHNOLOGIES

Techno-Economic Assessment of a Solar PV–Battery Energy Storage System for Peak Power and Demand Side Management in Indian Railways

D. Boruah[1*]

[1]*Global Sustainable Energy Solutions India Pvt. Ltd., New Delhi, India*

**Corresponding author: dwipen.boruah@gses.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.92

Abstract

Indian Railways is increasingly integrating renewable energy into traction power procurement with a target to achieve net zero by 2030. However, variability in solar generation and deviations between scheduled and actual power are likely to increase dependence on power exchanges and Deviation Settlement Mechanism (DSM) charges. This study evaluates a grid-connected solar photovoltaic (PV) and battery energy storage system (BESS) proposed for Indian Railways at Dahod, Gujarat, with the objective of supplying firm renewable power, managing DSM, and reducing electricity procurement costs. A 15-minute time-series analysis of scheduled power, actual supply, deviations, and exchange tariffs over 434 days from February 2023 to May 2024 was combined with PV generation modelling using ARKA 360 and hourly Meteonorm solar data. BESS sizing was assessed for DSM management, mitigation of scheduled power deviations, and firming of variable PV output, followed by techno-economic and scenario analyses. The study indicates that a 24.89 MWp DC (21 MW AC) PV plant can be accommodated within the available 90-acre site, with a minimum 50 MWh BESS recommended for DSM and firm-power scheduling. Approximately 76% of PV+BESS energy can support DSM, while 24% of PV energy can directly replace exchange power. The estimated project LCoE ranges from INR 3.27 to 4.05/kWh across scenarios, with a base-case post-tax project IRR of 8.38% and payback period of 13.3 years. The analysis demonstrates that PV+BESS can improve renewable-energy utilisation, reduce exposure to high-cost peak electricity, and provide measurable long-term savings for railway traction power procurement.

Keywords: *battery energy storage system; demand-side management; Indian Railways; peak power management; solar photovoltaic; techno-economic analysis*

EN-04 ORAL PRESENTATION · ENERGY TRACK · GREEN BUILDINGS AND CITIES

Solar-Integrated Hybrid Mechanical Ventilation for Energy-Resilient Office Buildings in Tropical Climates: A Simulation-Based Case Study in Jaffna, Sri Lanka

U. Thanapalasingam[1*]

[1]*Tech Onshore MEP Prefabricators, Singapore*

**Corresponding author: thanapalasingamumesh@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.93

Abstract

Tropical office buildings need effective ventilation for thermal comfort and indoor air quality, yet electrically powered mechanical ventilation increases grid electricity use and reduces resilience during power interruptions. This study presents a solar-integrated Hybrid Mechanical Ventilation System (HMVS) for the Regional Manager's Office Building of the National Water Supply and Drainage Board (NWSDB) in Jaffna, Sri Lanka, where mechanical fans supplement natural airflow only when needed. The design was developed through four stages: (1) assessment of the building and ventilation zones; (2) duct-system design using the equal-friction method and ASHRAE loss coefficients to size ducts, determine pressure losses, and select fans; (3) evaluation of airflow, velocity, and pressure distributions using ANSYS simulation; and (4) sizing and performance assessment of a rooftop solar photovoltaic (PV) system using PVsyst. The analysis yielded a required airflow of approximately 1 m^3/s, supply and return pressure losses of approximately 294 Pa and 182 Pa, and an estimated fan power requirement of approximately 24 kW. The sized rooftop PV system, approximately 120 kWp, is estimated to generate approximately 164 MWh annually, contributing substantially to the ventilation system electricity demand and reducing dependence on grid electricity. These design-stage results, produced prior to implementation and commissioning, show that combining solar PV with hybrid mechanical ventilation can reduce grid dependence and improve resilience during power interruptions, offering a practical approach for energy-efficient office buildings in tropical climates.

Keywords: *energy resilience; green buildings; hybrid mechanical ventilation; renewable energy; solar photovoltaic; sustainable buildings*

EN-31 ORAL PRESENTATION · ENERGY TRACK · GREEN BUILDINGS AND CITIES

Greening the Built Environment: Energy Efficiency and Sustainable Urban Transitions in Emerging Economies

S. Mukherjee[1*]

[1]*Xavier Business School, St. Xavier's University, Kolkata, India*

**Corresponding author: sovik1992@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.94

Abstract

Rapid urbanisation is increasing the energy and environmental footprint of buildings across emerging economies, making the built environment a critical arena for achieving sustainable energy transitions. This study examines whether green building investment and renewable energy integration improve energy efficiency in emerging economies and whether institutional quality strengthens these effects. Using a panel of 30 emerging economies over 2005–2025, the study analyses building-sector energy intensity as the principal outcome variable, with green building investment, renewable energy share, urbanisation and regulatory effectiveness as the main explanatory factors, while controlling for income per capita and trade openness. Data are compiled from the World Bank's World Development Indicators, the International Energy Agency and the United Nations Environment Programme databases. We estimate a dynamic panel model using the System Generalised Method of Moments (System GMM) to account for the persistence in energy intensity, potential endogeneity, and country-specific dynamics. We use fixed-effects estimation with Driscoll-Kraay standard errors as a robustness check. The analysis indicates that greater investment in green buildings and stronger integration of renewable energy are associated with lower building-sector energy intensity and improved environmental performance. Nevertheless, the magnitude of these gains depends significantly on regulatory effectiveness, suggesting that technological and architectural interventions alone may be insufficient where institutional capacity is weak. The findings argue for an integrated approach to sustainable urban development in which energy-efficient building design, renewable energy systems, supportive regulation, and green financing operate together.

Keywords: *emerging economies; energy efficiency; green buildings; institutional quality; renewable energy; sustainable urban development*

EN-47 ORAL PRESENTATION · ENERGY TRACK · GREEN BUILDINGS AND CITIES

Integrating Energy Efficiency and Thermal Comfort in Educational Buildings: Evaluating Passive and Hybrid Strategies for Improved Performance in the Climatic Context of Coimbatore, India

N. Venkatramakrishnan[1*] and P. Sudhakaran[1]

[1]*Amrita School of Architecture, Amrita Vishwa Vidyapeetham, Coimbatore, India*

**Corresponding author: vv_nivethitha@cb.amrita.edu*

DOI: https://doi.org/10.31705/ICEWSE.2026.95

Abstract

The building sector is one of the largest contributors to global energy consumption. Therefore, the transition to energy-efficient buildings is a priority for sustainable development. Educational buildings, in particular, offer high potential for energy efficiency because of the occupancy, long operating hours, and varied spatial requirements. Coimbatore is one of South India's prominent educational cities and is home to many state-owned universities. With rising energy prices and growing concern for environmental sustainability, the need for sustainable solutions in educational buildings is becoming more acute. Thermal comfort and energy efficiency are interdependent goals in building design. In South India's tropical climate, achieving thermal comfort while reducing reliance on mechanical cooling requires an integrated approach that accounts for the local climate, building form, envelope characteristics, orientation, natural ventilation, day lighting, renewable energy, and occupant behaviour. The research will combine field-based environmental measurements, occupant perception studies, and case-study analysis. Extensive research shows that, during design, it is essential to consider passive and easy-to-use hybrid techniques in institutional settings to tailor the learning environment. The study aims to conduct an objective survey and a subjective analysis, in line with standard regulations for students' thermal conditions in an institution, supported by case studies. The study will consider comfort parameters such as air temperature, mean radiant temperature, air velocity, and humidity, documented in line with existing conditions and the tropical Semi-Arid climate of Coimbatore. This will educate and enable architects, planners, and users to understand and tailor classroom comfort conditions, paving the way for energy efficiency.

Keywords: *easy-to-use hybrid techniques; educational buildings; energy consumption; passive techniques; thermal comfort*

EN-50 ORAL PRESENTATION · ENERGY TRACK · GREEN BUILDINGS AND CITIES

Sustainable Cost Control for Green Buildings in Sri Lanka: Integrating Life-Cycle Value and Environmental Performance

I. G. W. R. Jayaweera[1*] and K. A. P. B. K. Arachchi[1]

[1]*Department of Quantity Surveying, Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defence University, Southern Campus, Sri Lanka*

**Corresponding author: vimansijayaweera@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.96

Abstract

The construction sector plays a significant role in resource consumption and environmental impacts, creating a growing need for cost management approaches that support sustainable and environmentally responsible building development. Green buildings can contribute to improved resource efficiency and long-term environmental performance; however, higher perceived initial costs and inadequate cost-control practices remain important challenges to their wider adoption in Sri Lanka. This study investigates industry perspectives on the importance of sustainable cost control in Sri Lanka's green building sector, with particular emphasis on lifecycle costing, environmental performance, procurement practices, and long-term value creation. A mixed-method research approach was adopted, combining a questionnaire survey with semi-structured interviews involving construction industry professionals. Quantitative data were analyzed using descriptive statistics and the Relative Importance Index (RII), while interview responses were examined through thematic analysis. The findings indicate that green building cost control is perceived as more challenging than conventional cost management practices, while sustainability considerations are frequently incorporated at later stages of the project. The findings further highlight limitations in the application of lifecycle costing, integration of environmental objectives into cost planning, procurement practices, and institutional and regulatory support. Industry perspectives also emphasize the importance of early collaboration among quantity surveyors, designers, and other project stakeholders, together with the use of BIM and digital technologies to integrate cost and environmental information. The study highlights the need to shift from short-term initial-cost considerations towards lifecycle value-based decision-making to support economically viable, resource-efficient, and environmentally sustainable green buildings in Sri Lanka.

Keywords: *environmental performance; green buildings; lifecycle costing; Sri Lanka; sustainable construction; sustainable cost control*

EN-55 ORAL PRESENTATION · ENERGY TRACK · GREEN BUILDINGS AND CITIES

Developing a Framework for Energy Efficiency and Climate Resilience in House Construction in Tropical Lowlands and Uplands

D. W. T. S. Dissanayake[1*], H. G. L. N. Gunawardhana[1], C. Jayasinghe[1] and R. Weerasinghe[2]

[1]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*
[2]*Department of Mechanical Engineering, University of Bedfordshire, Luton, United Kingdom*
**Corresponding author: dissanayakedwts.25@uom.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.97

Abstract

Residential buildings in tropical climates face growing challenges from high cooling energy demand and indoor thermal discomfort, creating a need for energy-efficient housing strategies. This study investigates how building envelope and geometric parameters affect thermal behaviour in residential buildings, with particular relevance to Sri Lanka's lowland tropical climate. The study adopts a dynamic building performance simulation approach using DesignBuilder and EnergyPlus to evaluate the effects of wall and roof construction, window-to-wall ratio (WWR), and building orientation. Wall and roof materials were selected based on their relevance to Sri Lankan residential construction. A sensitivity analysis dataset was generated to evaluate variations in annual cooling energy demand under different design configurations. Preliminary results indicate appreciable differences in cooling energy demand among alternative wall and roof constructions, with roof construction showing a comparatively higher influence within the simulated configurations. Wall construction also influenced cooling energy demand, with Autoclaved Aerated Concrete (AAC) blocks and Expanded Polystyrene (EPS) based wall configurations exhibiting lower mean cooling energy demand than conventional brick and cement-block constructions in the simulated cases. The results demonstrate the importance of material selection in tropical residential building performance and provide a basis for subsequent sensitivity and data-driven analysis. The completed study will further evaluate the interactions among building, climatic, and operational parameters and translate the identified relationships into a practical climate-responsive design framework. The study is expected to contribute to improved decision-making for energy-efficient and thermally resilient residential construction in tropical climates.

Keywords: *building envelope and geometry; DesignBuilder/EnergyPlus; energy-efficient housing; sensitivity analysis; tropical climates*

EN-01 ORAL PRESENTATION · ENERGY TRACK · GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

Sustainable Integration of Rooftop Solar Photovoltaic Systems in Sri Lanka: Growth Drivers, Constraints, and Regulatory Priorities

S. A. C. Rajapaksa[1*], H. P. R. C. Kumara[1]

[1]*Public Utilities Commission of Sri Lanka, Colombo 02, Sri Lanka*

**Corresponding author: amilar@pucsl.gov.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.98

Abstract

Sri Lanka's rapid expansion of Rooftop Solar Photovoltaic (RTSPV) systems has increased distributed renewable generation and created technical, regulatory, institutional, and consumer-protection challenges. This study examined the adequacy of the existing regulatory framework and compliance with the regulatory tools by stakeholders to support the sustainable integration of rapidly growing RTSPV capacity. An evidence-based case-study approach was adopted using nationwide installed RTSPV capacity data from 2013 to September 2025. The study included a categorical analysis of 113 complaints received by the Public Utilities Commission of Sri Lanka during 2022–2025, 55 complaints reported to the Sri Lanka Sustainable Energy Authority during 2024/2025, and a review of existing regulatory tools. The analysis shows that RTSPV capacity increased from approximately 3 MW across 550 consumers in 2013 to 2,090 MW across 129,302 consumers by September 2025. Capacity more than doubled from 657 MW in 2022 to 1,401 MW in 2024 following the introduction of the Net Plus scheme and an export tariff of LKR 37/kWh, which demonstrated strong responsiveness of the industry to the policy changes. Tariff and grid-clearance issues accounted for 46.0% of PUCSL complaints, while recurring aftersales, warranty, installation-quality, and service-continuity issues were identified in the qualitative review. Policy and technical analysis further identified hosting-capacity constraints, voltage rise, inconsistent inverter settings, limited system visibility, and non-uniform practices as barriers to sustainable growth. The study contributed to identifying the gaps in the existing framework and addressing tariff stability, harmonized interconnection procedures, compliance monitoring, and requirement to strengthen installer accountability and consumer protection.

Keywords: *consumer protection; grid integration; hosting capacity; regulatory framework; rooftop solar photovoltaic; Sri Lanka*

DOI: https://doi.org/10.31705/ICEWSE.2026

EN-17 ORAL PRESENTATION · ENERGY TRACK · GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

The Green Investment Paradox: Renewable Capacity, Institutional Quality, and the Limits of Productive Conversion in Morocco

K. Brhaiberh[1*] and M. Ziky[1]

[1]*Research Laboratory on Innovation, Responsibility, and Sustainable Development (INREDD), Faculty of Economics and Management, Cadi Ayyad University, Marrakech, Morocco*

**Corresponding author: k.brhaiberh.ced@uca.ac.ma*

DOI: https://doi.org/10.31705/ICEWSE.2026.99

Abstract

As emerging economies race to expand renewable energy capacity, a critical question remains understudied: does installing green infrastructure automatically translate into economic growth, or does that depend on the institutions meant to convert it? Morocco offers a striking test case: despite two decades of ambitious policy, including Law 13-09 (2010) and the Noor solar complexes, the gap between installed renewable capacity and effective renewable generation has never closed, ranging from 6 to 21 percentage points and widening again since 2020 to reach 18.3 points in 2023. This study tests whether institutional quality explains this persistent gap, using two parallel Autoregressive Distributed Lag (ARDL) models estimated on annual data (2000–2023, N=24) and validated by bounds cointegration and Toda-Yamamoto causality tests. The interaction between installed capacity and institutional quality is significant and negative (p=0.001): renewable capacity's growth effect weakens, not strengthens, as governance improves, a result confirmed by three robustness checks. The equivalent interaction for effective consumption is weaker in the full sample (p=0.061) but reaches conventional significance in two of the three checks, revealing an asymmetry between investment and use. A persistent carbon lock-in effect compounds this picture: CO_2 emissions per capita remain positively and significantly linked to growth. These findings relocate the green investment paradox from a regulatory deficit to a deeper, time-varying disconnection between renewable investment and the institutional environment meant to convert it into growth, a lesson relevant to any energy-importing economy pursuing an ambitious renewable transition.

Keywords: *ARDL bounds test; carbon lock-in; green investment paradox; institutional quality; Morocco; renewable energy transition*

EN-35 ORAL PRESENTATION · ENERGY TRACK · GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

In Search of Clean Energy: India's Energy Diplomacy in the Global Disorder

A. Davis V[1*]

[1]*Department of Political Science, St. Xavier's College, Vaikom, Kerala, India*

**Corresponding author: ancydavis412@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.100

Abstract

Climate change and energy insecurity are among the most serious threats facing the world today. Recent unrest at maritime choke points, particularly the Strait of Hormuz, the continuing Russia–Ukraine conflict and insecure sea lanes are pushing countries to seek secure, clean energy sources. India, the world's most populous country, a fast-growing economy and a middle power, needs clean energy sources and technologies for its future development. Using a qualitative and descriptive method, this paper examines India's diplomatic engagements to secure its energy needs through bilateral, minilateral and multilateral cooperation, and how these engagements advance clean energy in the Global South. It also examines India's cooperation with Small Island Developing States (SIDS) in the Indo-Pacific in pursuit of climate justice. The findings show that India continues to meet its energy requirements through major suppliers such as the United States, Russia and countries of West Asia and the Middle East, while engaging in global clean energy initiatives: it is a partner in the International Solar Alliance and has launched the Global Biofuel Alliance. Its cooperation with Australia, New Zealand, South Korea, Japan, the European Union and ASEAN focuses on clean energy and the transfer of clean energy technology. India assists neighbouring countries and SIDS in the Indo-Pacific in establishing clean energy initiatives, while its cooperation with Latin American countries centres on access to critical minerals. The paper concludes that these initiatives, taken together, contribute to climate justice.

Keywords: *clean energy; climate justice; energy diplomacy; energy security; Indo-Pacific; International Solar Alliance*

EN-10 ORAL PRESENTATION · ENERGY TRACK · RENEWABLE ENERGY TECHNOLOGIES

Design and Sizing of a Bamboo-Pellet-Fired Travelling-Grate Water-Tube Boiler and Integrated Steam Sterilization Chamber for Mushroom Growing-Media Sterilization

T. K. S. Pushpakumara[1*], S. A. M. A. N. S. Senanayake[1] and P. N. R. J. Amunugoda[2]

[1]*Department of Mechanical Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka, Nugegoda, Sri Lanka*

[2]*Industrial Technology Institute, Malabe, Sri Lanka*

**Corresponding author: sandunpushpakumara2013@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.101

Abstract

In the study, the technical feasibility of selected Sri Lankan bamboo biomass was assessed as a renewable fuel to be burned in saturated-steam generation in mushroom growing-media sterilization and an integrated bamboo-pellet-fired travelling-grate water-tube boiler and sterilization chamber was developed. Four mature bamboo species *Dendrocalamus asper*, *Dendrocalamus giganteus*, *Bambusa vulgaris* green culm and *Bambusa vulgaris* yellow culm were characterized by the following tests: proximate analysis, CHN elemental analysis, Sulphur determination and calorific-value testing. Species level differences were found, and *D. asper* had the highest overall fuel-suitability ranking, while *D. giganteus* was chosen as the conservative boiler design fuel, due to its low moisture, high volatile matter, relatively low ash, low nitrogen, low heating value. The sterilization system was designed for 100-120 kg batch of substrate with requirement of 414.45 kg steam for 4.5-hour sterilization cycle, average steam requirement 92.1 kg/h and peak steam demand about 108 kg/h. To load, the chamber was designed in a horizontal format of 700 mm x 2000 mm. This resulted in the specification of a 200 kg h^{-1} travelling-grate water-tube boiler with a 317-kW combustion input, 147 kW steam duty, 0.64 m^2 grate, staged combustion air, natural circulation and built-in steam distribution, condensate drainage, air removal, instrumentation and safety interlocks. The results show the technical potential for use of bamboo in renewable process steam generation, but prototype validation, emissions tests, techno-economic analysis, life-cycle analysis and verification of the fuel-supply are still needed for commercialization.

Keywords: *bamboo biomass; fuel characterization; mushroom growing-media sterilization; renewable process heat; saturated steam; travelling-grate water-tube boiler*

EN-19 ORAL PRESENTATION · ENERGY TRACK · RENEWABLE ENERGY TECHNOLOGIES

Techno-Economic Feasibility of a Solar PV–Battery–Diesel Hybrid System for an Isolated Island Grid in Vanuatu

D. Boruah[1*] and P. Kumari[1]

[1]*Global Sustainable Energy Solutions India Pvt. Ltd., New Delhi, India*

**Corresponding author: dwipen.boruah@gses.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.102

Abstract

Small island electricity systems often depend on imported diesel fuel, resulting in high operating costs, energy-security risks and greenhouse gas emissions. This study assesses the techno-economic feasibility of integrating solar photovoltaic (PV) generation and battery energy storage with the diesel-based electricity system at Saratamata Electricity Services on Ambae Island, Vanuatu. A site survey, load assessment, solar resource assessment, system configuration study and techno-economic analysis were conducted. System sizing and optimisation were performed using GSES in-house tools, ARKA360 and HOMER Pro, with results compared under site-specific conditions. The proposed hybrid system comprises a 120 kWp ground-mounted PV array, a 350-kWh lithium-ion battery energy storage system with 75 kW grid-forming inverter capacity, and two 40 kW diesel generators. The system is estimated to supply 177 MWh of solar electricity annually against an annual demand of 200.28 MWh. This could reduce diesel consumption by approximately 29,230 L/year and avoid about 177 tCO_2/year of emissions. The estimated project cost is USD 477,735. Under the base-case scenario, the levelised cost of electricity is USD 0.27/kWh, the project payback period is 6.06 years, the project internal rate of return is approximately 17%, and the equity internal rate of return is 24%. The results demonstrate that PV-BESS integration can reduce diesel dependence while maintaining reliable electricity supply in an isolated island grid. The study provides a practical framework for renewable-energy integration and diesel displacement in the Pacific Island electricity systems.

Keywords: *battery energy storage; diesel hybrid system; island grid; solar photovoltaic; techno-economic feasibility; Vanuatu*

EN-21 ORAL PRESENTATION · ENERGY TRACK · RENEWABLE ENERGY TECHNOLOGIES

Design and Optimization of a Thermoelectric Generator for Waste Heat Recovery and Enhanced Green Energy Harvesting

Md. S. Mahmud[1*], Md. M. Rahman[1], P. Saha[1], F. A. Farha[1], C. G. J. Prakash[2] and P. Ravindran[3]

[1]*Department of Electrical and Electronic Engineering, University of Asia Pacific, Dhaka, Bangladesh*
[2]*Department of Mechanical Engineering, Chosun University, Gwangju, South Korea*
[3]*Department of Green Energy Technology, Pondicherry University, Puducherry, India*
**Corresponding author: sultan_mahmud@uap-bd.edu*
DOI: https://doi.org/10.31705/ICEWSE.2026.103

Abstract

Thermoelectric generators consist of multiple thermocouples, each made of two conductors, two semiconductor materials, and insulators, connected to form a sandwich layer. One side is the hot junction and the other the cold junction. The temperature difference causes charge carriers to diffuse, creating a voltage. This voltage is proportional to the temperature difference. However, in our studies, our main focus is to develop an efficient thermoelectric generator for PV modules. This thermoelectric generator will extract heat from the PV module and enhance the overall performance of the PV-TEG configuration across various solar power plant types, such as Rooftop, Floating PV, and Canal Top PV. Initially, we created the geometry of N- and P-type Bi2Te3 thermocouples, then incorporated various materials such as copper, aluminum, and nickel as conductors, alumina as the insulating material, and aluminum as a fin-type heat sink and hereafter added various load as resistor using COMSOL Multiphysics and simulated and measure the voltage and current whereas the Cu-TEG (Thermocouple)-Cu-Aluminum (Heat Sink) configuration showed the better performance than other configuration. Based on the single-pair thermocouple results, we built a 128-thermocouple thermoelectric generator and added a water-cooling system while keeping the best configuration. This indicates that integrating it with PV power plants as a PV-TEG can boost power output and enhance green energy harvesting systems.

Keywords: *cooling; PV-TEG; thermocouples; thermometric module; waste heat*

EN-33 ORAL PRESENTATION · ENERGY TRACK · RENEWABLE ENERGY TECHNOLOGIES

Towards Equitable Residential Energy Systems: Exploring Justice in Residential Solar and Battery Storage Deployment

N. Jayaraj[1*] and S. Anandaraj[1]

[1]*Regen Power Pty Ltd, Canning Vale, Western Australia, Australia*

**Corresponding author: research@regenpower.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.104

Abstract

The global transition to low-carbon energy systems increasingly relies on distributed energy technologies such as residential solar and battery storage systems. Although these technologies offer substantial financial, environmental and energy security benefits, uneven adoption patterns reveal structural and social barriers to inclusive participation. This study applies the Energy Justice framework to examine how distributional, procedural and recognition dimensions shape residential energy transitions. Drawing on 20 semi-structured interviews with residential end-users and policymakers, the study captures a range of perspectives on the drivers and barriers to solar and battery adoption. The findings reveal significant distributional inequalities, including high upfront costs and inadequate financial incentives, which restrict adoption largely to higher-income households. Equitable access is further constrained by procedural challenges, such as complex administrative processes, limited public awareness, and insufficient stakeholder participation. The study also identifies recognition-related inequalities, with low-income households, renters, and rural populations frequently excluded from energy transition programs. These procedural and recognition challenges compound distributional inequalities, illustrating the interconnected nature of these three justice dimensions. Through an energy justice lens, the study offers actionable insights for policymakers to design more targeted interventions, including financial support for disadvantaged groups, simplified administrative procedures, and improved information dissemination. Ultimately, the research demonstrates that ensuring equity and inclusivity in residential solar and battery storage adoption is essential not only for achieving sustainable energy goals, but also for building lasting public trust in the transition toward low-carbon energy systems.

Keywords: *battery storage; energy justice; policymakers; residential solar; sustainable energy*

EN-37 ORAL PRESENTATION · ENERGY TRACK · RENEWABLE ENERGY TECHNOLOGIES

Assessment of Suitable Locations for Ocean Thermal Energy Conversion Development in Sri Lankan Waters

D. S. N. K. Sathsarani[1*], W. A. A. P. Wijesundara[1] and S. U. P. Jinadasa[1]

[1]*Department of Oceanography, Ocean University of Sri Lanka, Colombo 15, Sri Lanka*

**Corresponding author: nethunisathsarani010@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.105

Abstract

Sri Lanka possesses significant Ocean Thermal Energy Conversion (OTEC) potential, yet the most suitable coastal sites for its development have not been systematically identified. This study addresses this gap by evaluating prospective sites for a closed-cycle, offshore OTEC system within Sri Lanka's Exclusive Economic Zone using satellite observations and reanalysis datasets. Four candidate sites, Trincomalee, Pasikudah, Dondra, and Panadura, were assessed using thermal gradient, bathymetric accessibility, mixed layer depth, current characteristics, wind and wave climate, and projected power output. Results show the thermal gradient between surface (0–50 m) and deep waters (900–1100 m) consistently exceeds the 20 °C threshold for efficient OTEC operation, with mean values of 21 to 23 °C across sites. Deep water (1000 m) is accessible within 10.5 km off Dondra, 25.2 km off Pasikudah, 25.8 km off Trincomalee, and 36 km off Panadura, with Dondra offering the shortest intake distance. Mixed layer depths range from 15 to 18 m across the Trincomalee and Pasikudah areas, while mean current speeds of 0.17 to 0.30 m/s show seasonal variability linked to monsoonal circulation. Estimated gross power outputs range from 5.63 to 6.0 MW, with net outputs of 5.58–5.94 MW; Trincomalee records the highest net power, closely followed by Pasikudah. Based on this comparison, Trincomalee and Pasikudah are identified as the most suitable sites, combining favorable thermal gradients, practical intake distances, and the highest net power outputs. These findings provide a scientific basis for prioritizing OTEC development locations in Sri Lanka, supporting sustainable electricity generation.

Keywords: *bathymetry; ocean thermal energy conversion; renewable energy; thermal gradient*

EN-46 ORAL PRESENTATION · ENERGY TRACK · RENEWABLE ENERGY TECHNOLOGIES

PVsyst-Based Comparative Performance Assessment of Ground-Mounted and Rooftop Solar PV Systems in an Educational Institution

S. Aravindh[1], Kinley Om[1], R. B. R. Rex[2] and R. A. Prasath[1*]

[1]*Department of Green Energy Technology, Pondicherry University, Puducherry, India*
[2]*School of Electrical Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India*
**Corresponding author: raprasath@pondiuni.ac.in*
DOI: https://doi.org/10.31705/ICEWSE.2026.106

Abstract

This study presents a four-year (2022–2025) comparative performance assessment of ground-mounted and rooftop grid-connected solar photovoltaic (PV) systems installed at an educational institution in Puducherry, India. The PV portfolio comprises 22 installations with an aggregate capacity of approximately 2.3 MWp. The site has a tropical climate with high solar availability, with global horizontal irradiation (GHI) of 5.14–5.28 kWh/m²/day and average ambient temperature of 27.84–28.60°C. Actual generation data were combined with meteorological data from the NASA POWER database, and a customized weather file was developed and implemented in PVsyst to evaluate performance. The analysis employed the energy evaluation methodology of IEC TS 61724-3, including Reference Yield (RY), Final Yield (FY), Specific Production, Performance Ratio (PR), incident irradiation, effective irradiation, PV array energy (E Array), and grid-injected energy (E Grid). The highest GHI and energy generation occurred in 2023, with annual array energy of 1,456,635 kWh and specific production of 1,621 kWh/kWp for the ground-mounted system, compared with 2,396,993 kWh and 1,572 kWh/kWp, respectively, for the rooftop system. The ground-mounted configuration achieved a higher annual Performance Ratio of 82.5–83.2%, while the rooftop configuration recorded 80.1–81.0%. Although the rooftop systems produced greater total energy due to their larger installed capacity, the ground-mounted systems demonstrated superior normalized performance. The results demonstrate that mounting configuration influences normalized PV performance, even when systems are evaluated within the same climatic environment, highlighting the importance of configuration-specific performance assessment for future solar PV deployment in educational institutions.

Keywords: *final yield; ground-mounted PV; IEC TS 61724-3; performance ratio; PVsyst; reference yield; rooftop PV; solar irradiation; solar photovoltaic performance; specific production*

SECTION

05

Poster Presentations

ARRANGEMENT

- Water Track posters: WAT-15, WAT-16, WAT-18, WAT-67, WAT-131 to WAT-136
- Energy Track posters: EN-34, EN-38, EN-49

WAT-15 POSTER PRESENTATION · WATER TRACK · URBAN WATER & RESILIENT INFRASTRUCTURE

Financial Performance and Sustainability of Municipal Water Supply Infrastructure in Kandy City

H. D. Jayathilake[1*]

[1]*Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Kandy, Sri Lanka*

**Corresponding author: hasithadilan.rrck@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.107

Abstract

Financial sustainability supports reliable municipal Water service delivery; many municipal utilities in developing countries lack a benchmarking framework for cost efficiency and revenue recovery. This study evaluates the financial performance of the Kandy Municipal Council (KMC) Water Works Division for 2023–2025, benchmarking cost, revenue, and efficiency indicators against Sri Lankan (SL) national averages. Annual operational cost data on electricity, chemicals, maintenance, and labour expenditure, together with Water production, revenue, and profit, were obtained from KMC financial records to calculate production cost per cubic meter, cost recovery ratio, and Non-Revenue Water (NRW) percentage. All financial values are operating expenditure only, excluding capital costs. Results show KMC's production cost ranged from LKR 32.8 to 35.6 per m³, close to the SL average of LKR 35.00/m³, with electricity as the main cost, exceeding LKR 400 million annually. The Cost Recovery Ratio remained high, at 130–190%, well above the 100% sufficiency threshold, yielding annual profits of LKR 185.6–451.9 million. However, NRW levels of 35–40% exceeded the national average of 25%, indicating significant revenue loss and operational inefficiency. Based on the three-year data and analysis, KMC is financially profitable but operationally inefficient relative to national standards. These findings are valuable as an initial analytical rather than confirmed long-term evidence. By integrating cost, recovery, and loss indicators within one clear framework, this study offers a replicable evaluation approach for municipal Water utilities in developing countries.

Keywords: *benchmarking; cost recovery; financial sustainability; municipal water supply; non-revenue water*

WAT-16 POSTER PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Satellite-Based Assessment of Drought Resilience of Small Reservoirs in the Dry Zone of Sri Lanka: A Case Study of the Mahakanumulla Village Tank Cascade System

S. A. C. D. Suraweera[1*], R. S. R. Rubasinghe[1]

[1]*University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: dilekasuraweera@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.108

Abstract

Small reservoirs in Sri Lanka's Dry Zone support irrigation and drought adaptation, yet tank-level resistance and recovery remain poorly quantified from satellite observations. This study developed a satellite-based drought-resilience framework for the Mahakanumulla Village Tank Cascade System. Twenty-seven clearly identifiable reservoirs suitable for repeated Sentinel-2 water-area extraction were purposively selected across six Grama Niladhari divisions, representing satellite-resolvable reservoirs rather than all water bodies. Sentinel-2 surface reflectance (April 2017–December 2025) was used to derive monthly water extent using the Modified Normalized Difference Water Index (MNDWI), vegetation exclusion, valid-pixel correction, and normalization to each tank's 95th-percentile observed water area. Independent field validation was unavailable; MNDWI threshold sensitivity (-0.05, 0.00, +0.05) produced a median threshold-induced area variation of 1.73% of P95 water area. Meteorological droughts during 2017–2025 were identified using CHIRPS-derived 3-month Standardized Precipitation Index (SPI-3) standardized against the 1981–2016 reference climatology. Events were contiguous negative-SPI-3 periods lasting ≥2 months and containing ≥1 month with SPI-3 ≤ -1.0. After monthly-climatology adjustment, resistance was one minus maximum seasonal deficit; recovery was exp(-t/6), where t was months for deficit to return to ≤0.10 within 12 months; event resilience was their geometric mean. Final resilience was the mean of eligible event scores weighted by cumulative SPI-3 deficit severity. Seven events were detected; five with adequate post-drought follow-up were recovery-scored. The most severe drought occurred during 2018–2019 (minimum SPI-3 = -1.65; cumulative severity = 7.74). Final resilience ranged from 0.639 to 0.988 (median 0.912), supporting targeted monitoring and field assessment.

Keywords: *drought resilience; remote sensing; Sentinel-2; SPI; Sri Lanka; village tank cascade systems*

WAT-18 POSTER PRESENTATION · WATER TRACK · COASTAL & MARINE WATER SYSTEMS

Mechanistic Evidence of Hidden Heterotrophic Metabolic Capacity and a Narrow Respiratory Safety Margin in Microbialised Paraviwella Reef, Sri Lanka

V. Lageeshan[1,2]*, M. F. M. Fairoz[1]

[1]*Department of Fisheries and Marine Science, Faculty of Fisheries and Ocean Sciences, Ocean University of Sri Lanka, Mahawela Road, Tangalle, Sri Lanka*

[2] *Marine Environment Protection Authority (MEPA), Sri Lanka*

**Corresponding author: Lageeshan101@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.109

Abstract

Coral reef microbialization represents a fundamental biogeochemical reorganization in which coral-derived energy pathways are replaced by heterotrophic microbial metabolism fueled by algal-derived organic matter. Although previous studies suggest that Paraviwella Reef in southern Sri Lanka exhibits characteristics of microbialization, its heterotrophic metabolic dynamics, respiratory potential, and associated physicochemical responses during organic matter degradation remain poorly characterized. This study provides a mechanistic assessment of long-term heterotrophic respiratory dynamics and physicochemical changes during organic matter degradation at Paraviwella Reef. Reef water was subjected to controlled dark-bottle incubation, while dissolved oxygen (DO), pH, biochemical oxygen demand (BOD_5), bacterial biomass gain, and microbial succession were assessed. Paraviwella exhibited strong heterotrophic oxygen-consumption potential, with approximately 4.53 mg O_2 L^{-1} consumed over 50 days ($R^2 = 0.87$, $p < 0.01$), accompanied by bacterial gain of approximately 0.6×10^5 cells mL^{-1}. The metabolic cost of microbial biomass production was approximately 3.8 mg O_2 per 1 µg microbial C produced. In-situ DO decline also supported natural heterotrophic respiratory potential. Respiratory dynamics showed intense initial oxygen consumption followed by stabilization, reflecting depletion of highly labile substrates and subsequent utilization of less bioavailable carbon pools, accompanied by microbial succession. Despite significant respiration-associated pH decline ($p < 0.05$), the magnitude remained low (≈0.005–0.01 pH units day^{-1}), while total alkalinity remained >180 mg L^{-1} as $CaCO_3$, indicating substantial buffering. Collectively, these findings demonstrate sustained heterotrophic respiratory processing and microbial restructuring, suggesting a narrow respiratory safety margin whereby continued organic matter enrichment may increase susceptibility to hypoxic microhabitats and reinforce microbialization.

Keywords: *carbon remineralization; copiotrophic microorganisms; coral reef microbialization; dissolved organic matter (DOM); heterotrophic microbial metabolism*

WAT-67 POSTER PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

After the Dam: Satellite-Based Assessment of Downstream Open-Water and Riparian-Corridor Greenness Following Moragahakanda Reservoir Impoundment, Sri Lanka

R. S. R. Rubasinghe[1*], S. A. C. D. Suraweera[1]

[1]*Department of Earth Resources Engineering, University of Moratuwa, Katubedda, Moratuwa, Sri Lanka*

**Corresponding author: officialsavindu@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.110

Abstract

Reservoir impact assessments often emphasize inundation and upstream effects, with downstream responses less documented. This study evaluated satellite-detectable open water and riparian-corridor greenness along 13.29 km of the Amban Ganga between Moragahakanda Dam and the Kalu Ganga confluence. Sentinel-2 Harmonized Level-1C imagery was analyzed for June–August (JJA) from 2016 to 2025, with 2016 as the pre-impoundment baseline, 2017 as the first-filling transition, and 2018–2025 as the operational period. JJA was selected because it is the driest three-month period in the 2000–2025 CHIRPS record, providing a window that reduces rainfall and phenological variability. Cloud-probability masking, mosaicking, NDWI and NDVI were applied within a 100 m buffer on either side of the river centreline. Robustness was assessed using NDWI thresholds, 50–200 m corridor widths, and a stable-land NDVI mask; CHIRPS and Landsat provided climatic and historical context. At an NDWI threshold of −0.05, detectable open water increased from 5.35 ha in 2016 to 10.79 ha in 2017 and averaged 10.32 ha during 2018–2025. Greenness showed no sustained increase through 2019 but remained above the 2016 baseline from 2020 onward. In 2024, JJA rainfall was similar to 2016 (191.52 versus 195.13 mm), yet open water was 104.4% greater and stable-land NDVI was 0.070 higher. Landsat-8 indicated that 2016 was not anomalous relative to 2013–2016 pre-impoundment conditions. Results indicate a temporally differentiated downstream response following impoundment, while rainfall variability, regulated diversions, canopy obscuration, atmospheric effects, and absent discharge data limit causal attribution.

Keywords: *downstream hydrology; Moragahakanda reservoir; NDVI; NDWI; riparian corridor; Sentinel-2*

WAT-131 POSTER PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Climate-Informed Spillway Design under Climate Projection Uncertainty for Horuwila Wewa

Md. R. Hassan[1*], C. Perera[1,2] and N. Wijayaweera[1,2]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management, University of Moratuwa, Moratuwa, Sri Lanka*
[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*
**Corresponding author: mrh.md.rakibhassan@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.111

Abstract

Water infrastructure design has traditionally relied on Intensity-Duration-Frequency (IDF) curves derived under the assumption of climate stationarity. Yet anthropogenic climate change has shifted extreme rainfall patterns in recent decades, making historical curves unreliable and heightening flood risk worldwide. Horuwila Wewa, an ancient reservoir in Anuradhapura with a 26.4 km^2 catchment in Sri Lanka's Dry Zone tank cascade system, increasingly struggles to manage extreme rainfall under a changing climate. This study quantifies climate projection uncertainty in future extreme rainfall and assesses its implications for spillway design at Horuwila Wewa. Using observed rainfall (1995–2024) and downscaled projections from three Coupled Model Intercomparison Project Phase 6 (CMIP6) General Circulation Models (GCMs) (CNRM-CM6-1, HadGEM3-GC31-LL, MRI-ESM2-0) under SSP2-4.5 and SSP5-8.5, 50-year return-period IDF curves were developed for 2041–2060 and 2081–2100. Daily extremes were estimated using the Gumbel distribution and disaggregated into sub-daily intensities using regional temporal distributions. The resulting IDF curves were incorporated into an uncalibrated HEC-HMS model to simulate reservoir inflows and determine the spillway length to maintain the target peak-pool stage under a 0.8 m bund-height increase. Results are interpreted as relative changes. Peak inflow varied from **−13.1% to +57.8%** relative to the 283.8 m^3/s baseline, reflecting substantial inter-model uncertainty. The most severe scenario (MRI-ESM2-0, SSP5-8.5, 2081–2100) required an **84% increase** in spillway length. These results demonstrate that climate projection uncertainty can substantially influence spillway design requirements. Incorporating multiple GCMs and SSPs into climate-informed IDF analysis provides a more robust basis for adapting reservoir infrastructure to future extreme rainfall.

Keywords: *climate change; CMIP6; HEC-HMS; IDF curves; projection uncertainty; spillway design*

WAT-132 POSTER PRESENTATION · WATER TRACK · SURFACE WATER HYDROLOGY & BASIN MANAGEMENT

Incorporating Dynamic Time of Concentration into Spillway Design under Future Climates: Knuckles Basin, Sri Lanka

S. T. Zaman[1*], R. L. H. L. Rajapakse[1] and N. K. Gunasekara[2]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management, University of Moratuwa, Moratuwa, Sri Lanka*
[2]*Department of Civil Engineering, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*
**Corresponding author: syedtakrimzaman@gmail.com*
DOI: https://doi.org/10.31705/ICEWSE.2026.112

Abstract

Spillway design in data-scarce tropical watersheds conventionally assumes a fixed time of concentration (Tc), although Tc shortens as rainfall intensity increases, and the effect of this dynamic behaviour on spillway design under future climates remains inadequately explored. This study assessed how dynamic Tc alters design peak discharges and spillway performance for the Pahala Halmillewa Wewa, downstream of the Knuckles Basin, Sri Lanka. Thirty years of daily rainfall (1995–2024) from Anuradhapura were downscaled using LARS-WG for three global climate models (CNRM-CM6-1, HadGEM3-GC31-LL and MRI-ESM2-0) under SSP2-4.5 and SSP5-8.5 for 2041–2060 and 2081–2100, producing 12 future daily rainfall series. These were disaggregated to short durations using Ponrajah's equation to develop Intensity-Duration-Frequency (IDF) curves. An existing rainfall-intensity-Tc relationship, developed using Detrended Moving-Average Cross-Correlation Analysis (DMCA), was adopted to estimate rainfall-intensity-dependent Tc. Design hydrographs were simulated in HEC-HMS using the SCS Unit Hydrograph method for a 50-year return period, followed by evaluation of spillway crest length, elevation, and discharge efficiency. Tc decreased linearly with rainfall intensity, indicating that fixed-Tc design can underestimate future flood peaks. Projected peak discharges ranged from 81.6 to 205.4 m^3/s against a baseline of 82.2 m^3/s, with the maximum, under MRI-ESM2-0 and SSP5-8.5 for 2081–2100, approximately 2.5 times the baseline, and considerable spread among models. A revised spillway (crest length increased from 58 m to 80 m; elevation raised from 72 m to 73 m) attenuated the peak discharge to 179.6 m^3/s. Incorporating dynamic Tc is therefore essential for climate-resilient spillway design in data-scarce tropical basins.

Keywords: *climate change; dynamic time of concentration; HEC-HMS; IDF curves; Knuckles Basin; spillway design*

WAT-133 POSTER PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Quantifying Spillway Upgrades and Storage Expansion for Kattiyawa Wewa Reservoir under Future Climate Projections

S. Akhter[1*], R. L. H. L. Rajapakse[1] and A. H. R. Ratnasooriya[1]

[1]*UMCSAWM, Department of Civil Engineering, University of Moratuwa, Sri Lanka*

**Corresponding author: shahrinakhter28@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.113

Abstract

Climate change is amplifying hydrological extremes and undermining the resilience of ageing water infrastructure, particularly in tropical data-scarce catchments. This study quantifies the spillway and storage requirements for Kattiyawa Wewa Reservoir, located in the Knuckles Basin, Sri Lanka, under future CMIP6 climate projections. Rainfall records and DEM data were integrated with three CMIP6 GCMs–CNRM-CM6, HadGEM-GC31-LL, and MRI-ESM2-0, under SSP2-4.5 and SSP5-8.5 for 2041–2060 and 2081–2100. Projections were downscaled using LARS-WG to derive intensity-duration-frequency curves (IDF) and drive HEC-HMS hydrological modelling. Design hydrographs, peak discharges, and DEM-based area-capacity curves were then used to evaluate reservoir augmentation and spillway upgrading. The baseline peak discharge (1994–2024) was 437.2 m^3/s. All future scenarios projected substantial increases, with HadGEM-GC31-LL yielding the most extreme flows: 1370.5 m^3/s (SSP2-4.5, 2041–2060), 1346.2 m^3/s (SSP2-4.5, 2081–2100), 1297.6 m^3/s (SSP5-8.5, 2041–2060), and 1378.1 m^3/s (SSP5-8.5, 2081–2100), exceeding baseline by up to 215%. Required spillway capacity is 1,100–1,200 m^3/s with storage expansion, or up to 1,380 m^3/s without. Existing infrastructure is inadequate under most scenarios. These findings provide globally relevant evidence for climate-resilient reservoir operation, dam safety, and adaptive water infrastructure planning. The integrated framework is transferable to other data-scarce tropical catchments and supports sustainable development goal (SDG 6 and SDG 13) by mainstreaming climate uncertainty into design standards and operational rules. It also bridges limited CMIP6-based reservoir safety assessments for the Knuckles Basin and offers actionable guidance for policymakers, engineers, and water managers, thereby enhancing long-term water security and flood resilience.

Keywords: *climate change; CMIP6; HEC-HMS; kattiyawa wewa; reservoir storage; spillway capacity*

WAT-134 POSTER PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Uncertainty Analysis of Probability Distributions in Design Rainfall Estimation for Spillway Design

A. R. L. S. Alahakoon[1*], T. M. N. Wijayaratna[1] and H. G. L. N. Gunawardhana[1]

[1]*UMCSAWM, Department of Civil Engineering, University of Moratuwa, Sri Lanka*

**Corresponding author: lihinisisaara@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.114

Abstract

Uncertainty in design rainfall estimation can significantly affect design flood prediction and the required capacity of spillways. This study investigates the uncertainty introduced by different probability distributions in design rainfall estimation and its implications for spillway design at the Kalankuttiya Reservoir catchment in Mahaweli System H, Sri Lanka. A 30-year annual maximum daily rainfall record was fitted to six probability distributions: Gumbel, Generalized Extreme Value, Log-Pearson Type III, Lognormal, Gamma, and Weibull. The distributions were evaluated using the Anderson-Darling, Kolmogorov-Smirnov, and Chi-square goodness-of-fit tests. Design rainfall for a 50-year return period was estimated using each distribution and incorporated into a HEC-HMS model to generate design flood hydrographs. The results showed considerable variation in design flood estimates among the distributions, with peak discharges ranging from 230.8 to 293.1 m^3/s. These discharges corresponded to required spillway lengths of approximately 45–59 m, compared with the existing 18 m spillway. The Anderson-Darling test identified Log-Pearson Type III as the best-fitting distribution, while the range of results demonstrated substantial uncertainty associated with distribution selection. The findings highlight that uncertainty in design rainfall estimation can propagate directly into spillway design requirements. These results emphasize the importance of incorporating distribution-related uncertainty when assessing spillway capacity and reservoir safety.

Keywords: *design rainfall; flood frequency analysis; HEC-HMS; probability distributions; spillway capacity*

WAT-135 POSTER PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Climate-Driven Rise in Consecutive Extreme Rainfall and Its Implications for Spillway Capacity: A Case Study in Manankattiya Reservoir, Sri Lanka

M. M. J. R. Malwattegedara[1*], H. G. L. N. Gunawardhana[1] and R. L. H. L. Rajapakse[1]

[1]*UNESCO Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), Department of Civil Engineering, University of Moratuwa, Moratuwa, Sri Lanka*

**Corresponding author: jayrasali101@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.115

Abstract

Spillways of irrigation reservoirs in Sri Lanka's dry zone are sized for a single design flood, an assumption increasingly challenged as climate change intensifies back-to-back extreme storms. When a second extreme event arrives before a full reservoir has released its surplus, the spillway must pass a flood volume it was not designed to convey. This study quantifies the projected rise in consecutive extreme rainfall at Manankattiya Reservoir and evaluates its consequences for spillway capacity. Observed daily rainfall (1994–2024) was used to generate future series with the LARS-WG stochastic weather generator, driven by three CMIP6 models under SSP2-4.5 and SSP5-8.5 for 2041–2060 and 2081–2100. Events exceeding 200 mm were classed as extreme, and pairs occurring within seven days as compound. The two largest compound events from each series, 22 in total, were simulated in HEC-HMS and routed through the reservoir to find the minimum crest length that keeps the peak level below the bund top. Under SSP5-8.5, compound events become 4.6 times more frequent by late century, from 0.06 to 0.30 events per year. Each event produces 25.5–46.7 MCM of inflow, four to eight times the 6.02 MCM storage, showing that spillway discharge capacity, rather than storage, governs reservoir safety. The required crest length increases from 13–19 m at present to as much as 24 m under future scenarios. These screening-level estimates, based on daily rainfall and a derived storage curve, should be verified against the probable maximum flood. The findings support incorporating consecutive extremes into spillway design standards.

Keywords: *bund overtopping; CMIP6 projections; compound hydrological events; HEC-HMS; irrigation tanks*

DOI: https://doi.org/10.31705/ICEWSE.2026

WAT-136 POSTER PRESENTATION · WATER TRACK · CLIMATE RESILIENCE & WATER SECURITY

Assessment of Design Flood Responses and Spillway Performances under Variations in Antecedent Soil Moisture Conditions, Rainfall Patterns and Hydrological Transformation Uncertainty in the Knuckles Basin

R. L. M. L. Rajasekara[1], P. K. C. De Silva[1] and R. L. H. L. Rajapakse[1*]

[1]*UMCSAWM, Department of Civil Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: madurilakshika46@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.116

Abstract

Reservoir operation under extreme events requires reliable design flood estimation while accounting for uncertainties in catchment response and rainfall characteristics. This study assesses the design flood response and spillway performance of the Maminiyawa Reservoir, Sri Lanka, under variations in antecedent soil moisture conditions, rainfall temporal patterns, and hydrological transformation. A scenario-based HEC-HMS modelling approach was employed using a 50-year return period design storm. Hydrological scenarios were developed by varying Curve Number (CN) to represent different antecedent soil moisture conditions, Peak Rate Factor (PRF) to represent hydrological transformation, and three rainfall temporal patterns: front-loaded, centrally loaded, and back loaded. Peak discharge and reservoir pool elevation were evaluated across the scenarios to identify the critical condition and assess potential overtopping. The simulated peak discharge ranged from 196.5 to 372.9 m^3/s, representing an 89.8% variation among the scenarios. Variations in runoff transformation parameters produced increases of up to 24.8% in peak discharge, while rainfall temporal distribution resulted in a maximum increase of 14.5% for the back-loaded pattern relative to the front-loaded pattern. Under the critical scenario, the peak discharge reached 372.9 m^3/s, and the reservoir pool elevation reached 140.2 m. As the bund level is 140 m, the simulated water level exceeded the bund by 0.2 m, indicating potential overtopping under the 50-year event. The findings highlight the importance of incorporating hydrological uncertainty into reservoir flood safety assessment and capacity enhancement planning.

Keywords: *extreme rainfall; hydrological modelling; reservoir routing; runoff generation*

EN-34 POSTER PRESENTATION · ENERGY TRACK · GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

Biomass-Derived Activated Carbons for CO_2 Capture: Preparation, Surface Engineering, Characterization, Adsorption Mechanisms and Industrial Applications

V. Ilamurugan[1], B. M. Jaffar Ali[2*]

Department of Green Energy Technology, Pondicherry University, Puducherry-605014, India

**Corresponding author: jaffarali.get@pondiuni.ac.in*

DOI: https://doi.org/10.31705/ICEWSE.2026.117

Abstract

The increasing concentration of atmospheric carbon dioxide resulting from human activities has raised significant challenges for climate change mitigation and environmental sustainability. Governments and regulatory authorities have introduced policies to control emissions from major industrial sources, including fossil-fuel-based power generation, petrochemical processing, and cement manufacturing. Among available carbon capture and storage approaches, adsorption using porous solid sorbents has received considerable attention for its simple operation, economic feasibility, and low energy requirements. Recent studies have identified solid sorbents, including amine-modified materials, zeolite adsorbents, metal-organic frameworks (MOFs), and porous carbon materials. However, some of these sorbents involve relatively expensive preparation, limited structural stability, and moderate adsorption capacity. In amine-functionalized sorbents, CO_2 interacts with surface amine functionalities, while the porous support facilitates gas diffusion and active-site distribution. Biomass-derived waste represents an attractive precursor for the preparation of activated carbon adsorbents due to its low cost, renewable nature, availability, and favourable carbon content. Agricultural residues classified as lignocellulosic biomass are broadly available in three forms, namely peels, shells, and seeds. They can be converted into porous carbon materials through pyrolysis, hydrothermal carbonization, and advanced heating methods. Diverse compositions of biomass bring variability in the properties of the derived carbon, which render different and enhanced CO_2 adsorption ability. Physical and chemical activation can further develop the pore structure in such a system and increase the specific surface area. Surface engineering can improve CO_2- surface interactions and selectivity. Heteroatom incorporation involving N, O, S, and P, together with metal oxides, can generate basic and reactive surface sites that enhance CO_2 adsorption. This review examines biomass-derived activated carbons for CO_2 capture, focusing on precursor selection, carbonization, activation, surface functionalization, characterization, adsorption isotherms, kinetic models, and mechanisms, including ultra-micropore and chemisorption. Finally, post-combustion CO_2 capture and large-scale industrial implementation are discussed.

Keywords: *activated carbon; biomass waste; carbon capture; climate change; CO2 sequestration; post-combustion*

EN-38 POSTER PRESENTATION · ENERGY TRACK · CIRCULAR ECONOMY AND SUSTAINABILITY

From Plastic Waste to Circular Value: Open Innovation Pathways for a Resilient and Sustainable Sri Lanka

V. Sinnathamby*

Postgraduate and Mid-Career Development Unit, Faculty of Management and Finance, University of Colombo, Sri Lanka
**Corresponding author: fmfdba2023-30@stu.cmb.ac.lk*
DOI: https://doi.org/10.31705/ICEWSE.2026.118

Abstract

Plastic pollution remains a persistent sustainability challenge in Sri Lanka, where transitioning from a linear waste model towards a circular economy requires not only technological solutions but also entrepreneurial capabilities, stakeholder collaboration and institutional adaptation. This paper examines how open innovation can enable plastic recycling enterprises to create circular value while responding to institutional pressures and resource constraints. The study adopts an interpretivist, qualitative, multiple-case study approach, informed by Institutional Theory, Institutional Logics, Stakeholder Theory, Open Innovation, and Circular Entrepreneurship. As an ongoing doctoral study, the present paper focuses on the conceptual and methodological foundations developed through a critical synthesis of the relevant literature and the Sri Lankan institutional context. The analysis indicates that circular entrepreneurship extends beyond material recovery and recycling technology, requiring enterprises to mobilise external knowledge, resources and stakeholder relationships, while navigating regulatory, market, social and environmental expectations. The resulting conceptual framework positions stakeholder engagement and open innovation as interconnected pathways through which resource-constrained enterprises can adapt to institutional pressures and generate economic, social and environmental value. The study concludes that strengthening collaborative innovation capabilities within the plastic recycling sector can support a transition from conventional waste management towards more resilient and sustainable circular resource management. The framework provides a basis for subsequent empirical investigation and offers practical relevance for policymakers, recycling enterprises and sustainability practitioners in emerging economies.

Keywords: *circular economy; circular entrepreneurship; open innovation; plastic recycling; resilience; stakeholder engagement*

EN-49 POSTER PRESENTATION · ENERGY TRACK · GREEN BUILDINGS AND CITIES

Promoting Urban Sustainability in Sri Lanka: The Role of Green Building Practices in Enhancing Environmental Health and Biodiversity

I. G. W. R. Jayaweera[1*], K. A. P. B. K. Arachchi[1]

[1]*Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defence University, Sri Lanka*

**Corresponding author: vimansijayaweera@gmail.com*

DOI: https://doi.org/10.31705/ICEWSE.2026.119

Abstract

Rapid urbanization in Sri Lanka has intensified environmental degradation, biodiversity loss, and climate-related challenges, highlighting the need for sustainable construction approaches that integrate environmental health and ecological resilience. This study evaluates how green building practices contribute to urban sustainability by enhancing environmental health, supporting urban biodiversity and strengthening long-term environmental resilience in Sri Lankan cities. A mixed-method research approach was adopted, combining a literature survey with a structured questionnaire administered to 180 construction professionals, including quantity surveyors, architects, engineers, project managers, and other industry stakeholders. Quantitative data were analyzed using the Relative Importance Index (RII), while qualitative responses and literature-based evidence were examined through thematic analysis. The findings demonstrate a relatively high level of awareness and implementation of green building practices, particularly waste management, sustainable material use, energy-efficient systems, water conservation and green-space integration. Biodiversity-related findings indicate that native plant use, habitat creation and biodiversity-sensitive architectural design are important approaches for strengthening urban ecological values, with the assessed biodiversity parameters recording RII values between 0.781 and 0.828. Nevertheless, loss of parks and vegetation, habitat fragmentation, air pollution, water contamination, and non-native species remain significant environmental and ecological challenges. The study concludes that green building practices can contribute to healthier, more resilient urban environments through sustainable resource management, ecosystem conservation, and climate adaptation. Strengthening policy implementation, stakeholder collaboration, professional capacity development, and investment in biodiversity-focused construction is therefore important for advancing sustainable urban development in Sri Lanka.

Keywords: *environmental health; green building practices; green infrastructure; urban biodiversity; urban sustainability*

SECTION

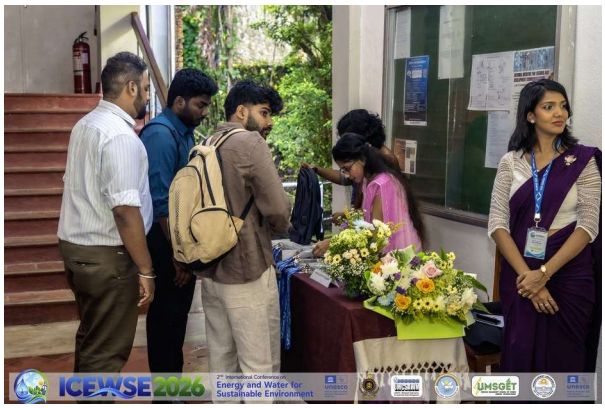
06

Memories from ICEWSE 2026

Moments from the two days of the conference.

MEMORIES · ARRIVAL AND WELCOME











MEMORIES · OPENING CEREMONY













MEMORIES · OPENING CEREMONY











MEMORIES · KEYNOTE ADDRESSES AND INVITED LECTURES









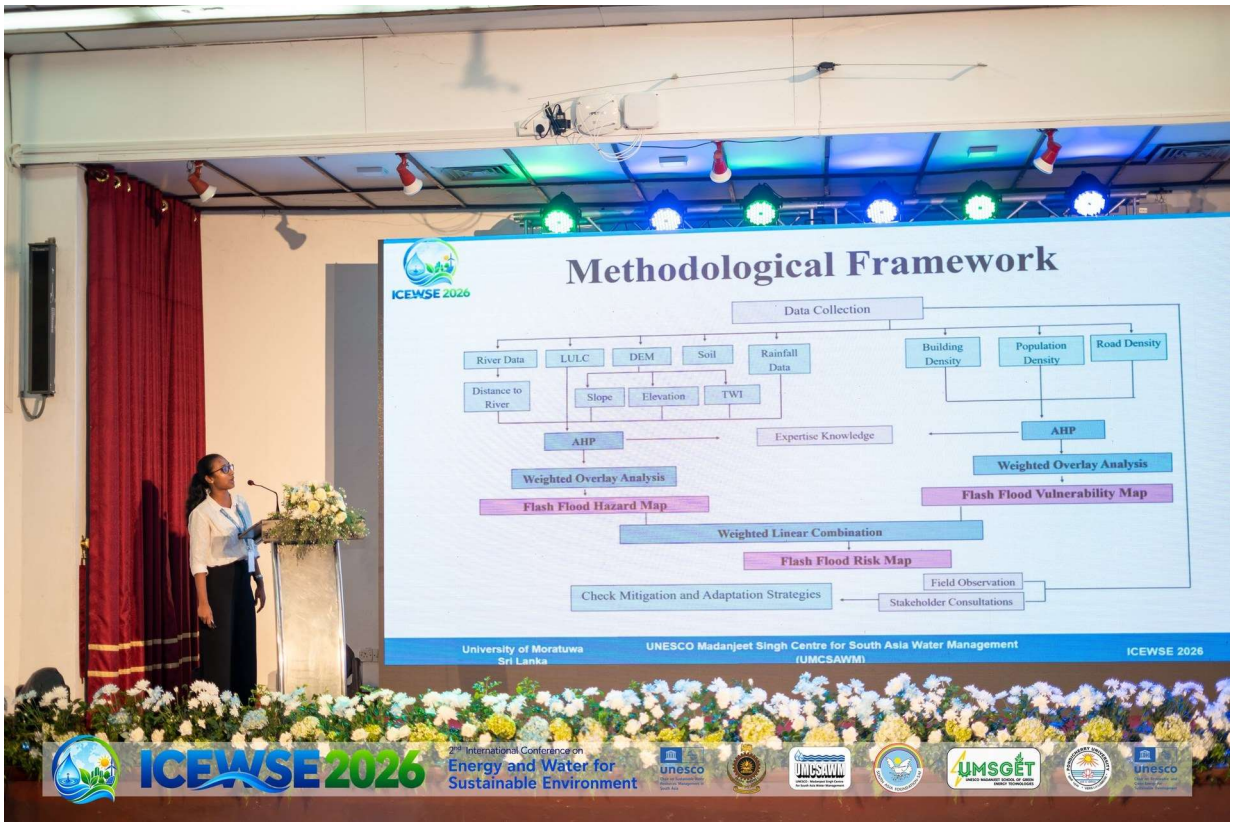








MEMORIES · TECHNICAL SESSIONS











MEMORIES · TECHNICAL SESSIONS

















MEMORIES · POSTER PRESENTATIONS











MEMORIES · AWARDS AND RECOGNITION











MEMORIES · GALA DINNER











MEMORIES · CULTURAL PROGRAMME













2ND ICEWSE 2026 CONVENORS

Prof. Lalith Rajapakse
UNESCO Chairholder on SWRMSA
University of Moratuwa
Sri Lanka

Prof. Ramaswamy Arun Prasath
UNESCO Chairholder on RCESD
Pondicherry University
India

ICEWSE 2026

2ND INTERNATIONAL CONFERENCE ON ENERGY AND WATER FOR SUSTAINABLE ENVIRONMENT

ADVANCING THE ENERGY-WATER NEXUS FOR A SUSTAINABLE AND RESILIENT FUTURE

ISSN 3121-5602

9 773121 560005

Tel: +94 11 774 7550 · icewse.publications@gmail.com · umcsawm.uom.lk/icewse-2026

#ICEWSE2026 #EnergyWater #Sustainable Future

UMCSAWM, University of Moratuwa,
Sri Lanka