

# Climate Change & Sustainable Development



**Edited by**  
**Pradeepan Periyat**  
**Manoj K**

# **CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT**

**Edited by**  
**Pradeepan Periyat**  
**Manoj K**



Centre for Atmospheric Sciences and Coastal Ecological Studies (CASCES)  
Department of Environmental Studies  
Kannur University

Copyright © Pradeepan Periyat and Manoj K. 2024

All rights reserved. No part of this book may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without permission in writing from the publisher.

*First published in 2024 by*

**Centre for Atmospheric Sciences and Coastal Ecological Studies (CASCES)**

Department of Environmental Studies

Kannur University

Kannur, Kerala, India

Published by Centre for Atmospheric Sciences and Coastal Ecological Studies (CASCES), Department of Environmental Studies, Kannur University, Kannur, typeset in 12/14pt Times New Roman and printed at Layam Commercial Printers, Mangattuparamba, Kerala.

**Editorial Board**

Editors : Dr. Pradeepan Periyat

Dr. Manoj K.

Members : Dr. Bindu M.

Dr. Thangavelu A.

Aishu A

Anjitha S.

Gatha R S

Reshma M S

Shwetha Suresh

ISBN: 978-81-967107-0-5



# Contents

<i>List of Tables</i>	i
<i>List of Figures</i>	ii
<i>Foreword by Dr. Pradeepan Periyat &amp; Dr. Manoj K</i>	iii

## SECTION I

### Impacts of Climate Change on Environment

#### CHAPTER 1

A Long-Term Interpretation of Rainfall Over India across the Climatic Episodes	3
<i>Brindha S., G. Udhaba Dora, Reshma M. S.</i>	

#### CHAPTER 2

A Study on Land Surface Temperature in Mangalore City of the Year 2016 Using RS and GIS Techniques	8
<i>Abhishek R., H. Gangadhara Bhat</i>	

#### CHAPTER 3

Ecological Dynamics and Environmental Challenges of Pookode Lake: A Comprehensive Review	12
<i>Gatha R S, Tharavathy N C</i>	

#### CHAPTER 4

Effect of Climate Change on Plant Productivity	16
<i>Nivin Kanth K., Manoj K.</i>	

#### CHAPTER 5

Interactions of Climate Change, Eutrophication, and Harmful Algal Blooms: Implications for Water Resource Management: A Comprehensive Review	18
<i>Gatha R S, Tharavathy N C</i>	

#### CHAPTER 6

Unearthing Urbanization Dynamics of Malappuram, Kerala: A Space-Based Approach	23
<i>Shilpa Sasidharan, Sumith Satheendran, Ayona Jayadev</i>	

## SECTION II

### Climate Change and Health

#### CHAPTER 7

Smoke Toxicity Assays of <i>Sphagneticola trilobata</i> (L.) Pruski Leaf Extracts (Crude) Against Dengue Vector <i>Aedes albopictus</i> (Diptera: Culicidae).	29
<i>Jiji P.V., Harilal C.C.</i>	

## **SECTION III**

### **Water Pollution and Sustainable Water Management**

#### **CHAPTER 8**

An Innovative Water Resource Conservation Measure for Managing Urban Ponds on OSM Platform 35

*Bindu K B*

#### **CHAPTER 9**

Assessing Natural Coagulants Effectiveness in Water Purification 38

*Ravi Kumar Goud, R. Shyam Sunder*

#### **CHAPTER 10**

Evaluation of Heavy Metal Characteristics in Ground Water Quality of Kannur Region, Kerala Using Geospatial Techniques 42

*Thangavelu A, Sapna K, Anjana C*

#### **CHAPTER 11**

Pillared Kaolinite Clay-Based Adsorption for the Removal of Heavy Metal from Aqueous Media 46

*N Akshaya, P. Periyat*

## **SECTION IV**

### **Environmental Nanotechnology**

#### **CHAPTER 12**

A Brief Evaluation of the Antifungal Effectiveness of Green Synthesized Copper Oxide Nanoparticles 53

*Anjitha S., P. Periyat*

#### **CHAPTER 13**

Introduction of Nanoscience – A Radical Change in Scientific Preservation of Stone Artifacts - A Felt Need Indeed 58

*Rahul P., P. Periyat*

#### **CHAPTER 14**

Nanolignin- A Renewable Feedstock for Green Technology Endeavors 64

*Poornima Ponnumani, Abdullah Al-Azemi, P. Periyat*

## **SECTION V**

### **Climate Change and Sustainable Development Goals**

#### **CHAPTER 15**

A Strategic Framework for Ecosystem Restoration: Recommendation for Future Plan of Action 71

*Anjana Anoop P. K., Manoj K.*

## **CHAPTER 16**

- Elemental (C and N) and Isotopic ( $\delta^{13}\text{C}$  AND  $\delta^{15}\text{N}$ ) Characterization of Particulate Matter (PM 10) at Trombay, Mumbai 75  
*Reshma M. S., V. B. Yadav*

## **CHAPTER 17**

- Quantification of GHGs Emission from Transportation Sector of Udayagiri Panchayath, Kannur District 81  
*Adithya Prakash M., Manoj K.*

## **SECTION VI**

### **Disaster and Sustainable Risk Management**

## **CHAPTER 18**

- Understanding and Mitigating Landslide Risks: A Case Study of the Kanichar and Kolayad Panchayath in Kerala, India. 87  
*Geethanandan Krishnan, Manoj.K, T. K. Prasad*

## **SECTION VII**

### **Sustainable Agriculture and Agroforestry**

## **CHAPTER 19**

- Allometric Assessment of Tree Growth and Economic Valuation: A Case Study of Teak, Rosewood, Xylia, and Sandalwood in the Kerala Forest Research Institute Main Campus, Peechi 95  
*Keerthana K, Adarsh C K*

## **CHAPTER 20**

- Evaluation of Agricultural Soil Quality in Micronutrient Analysis of Kasaragod Region Using Integrated GIS and Multivariate Statistical Analysis 98  
*Thangavelu Arumugam, Sapna Kinattinkara, Archana Jayaseelan*

## **SECTION VIII**

### **Clean Technology**

## **CHAPTER 21**

- A Brief Review on Renewable Energy Source Driven Hybrid Micro-Grids 105  
*V. B Murali Krishna*

## **CHAPTER 22**

- Synthesis, Characterization and Super Capacitor Applications of Semi conducting 2H Phase of MoS<sub>2</sub> 117  
*Anagha Sasi, Adarsh P, Hareesh, Govind Raj K, P. Periyat, Jithesh Kavil*

## **CHAPTER 23**

- Synthesis of Zeolites from Ground Nut Shell Ash 119  
*Shaga Ravi Kumar Goud, Y. Umarani, Swamy Kurella*

## **SECTION IX**

### **Nature-Based Solutions against Environmental Disasters and Climate Change**

#### **CHAPTER 24**

Efficiencies of Selected Grass Species in Curbing CO<sub>2</sub>: Inferences from A CO<sub>2</sub> Enrichment Study 125

*Sashna N.C. and Harilal C.C.*

#### **CHAPTER 25**

People's Awareness on Mangrove Degradation and Climate Change 129

*Varun K K*

## List of Tables

Figure 1	:	Study area map
Figure 2	:	2017 Urban Indices Range Value
Figure 3	:	3D–surface plots of mortality data
Figure 4	:	Heavy Metal Pollution Index
Figure 5	:	Adsorption of heavy metal from aqueous solution
Figure 6	:	Pillaring of clay minerals
Figure 7	:	Micelles at work
Figure 8	:	Structure of sodium pentachlorophenate ( $C_6Cl_5NaO$ )
Figure 9	:	Wacker Polymer
Figure 10	:	Schematic illustration of silane molecules forming a polysiloxane network and exhibiting hydrophobic effects on mineral substrates Wacker
Figure 11	:	Preparation of $TiO_2$ - sol from Titanium Tetra Isopropoxide
Figure 12	:	Applications of various nanomaterials
Figure 13	:	Variation of different parameters during the study period
Figure 14	:	Emission from transportation sector
Figure 15	:	Land slide location map
Figure 16	:	Land slide area
Figure 17	:	Spatial distribution of Zinc
Figure 18	:	A highly simplified schematic diagram AC-micro grid system
Figure 19	:	CV curves of 2H $MoS_2$
Figure 20	:	Charge-discharge curves of 2H $MoS_2$
Figure 21.a.	:	XRD pattern of ground nut shell ash
Figure 21.b.	:	XRD pattern of zeolite A
Figure 22	:	Workflow diagram of the experimental setup
Figure 23	:	The day and night fluxes of $CO_2$ in standardization study and study with grass species



## CHAPTER 6

### UNEARTHING URBANIZATION DYNAMICS OF MALAPPURAM, KERALA: A SPACE-BASED APPROACH

<sup>1</sup>Shilpa Sasidharan, <sup>1</sup>Sumith Satheendran S., <sup>2</sup>Ayona Jayadev

<sup>1</sup>Amrita-Natural Resource Monitoring Laboratory (Amrita-NRML), Earth Observation Group  
Amrita School of Physical Sciences, Department of Chemistry, Amrita Vishwa Vidyapeetham (Deemed  
University)

Amritapuri Campus, Kollam-690525, Kerala, South India

<sup>2</sup>Department of Environmental Sciences, All Saints' College, Thiruvananthapuram, 695007

#### ABSTRACT

Urbanization, a complex process of societal transformation, presents a dichotomy of benefits and challenges. This study delves into the dynamics of urbanization within Malappuram, employing European satellite Sentinel-2 imagery and eight carefully chosen indices to analyze urban built-up features. These indices include the Normalized Difference Built-up Index (NDBI), New Built-up Index (NBI), Built-up Area Extraction Index (BAEI), Normalized Built-up Area Index (NBAI), Normalized Difference Concrete Condition Index (NDCCI), Urban Index (UI), Built-up Index (BUI), and Enhanced Built-Up and Modified Built-up Area Index (MBAI). Each index captures distinct aspects of urban land use, facilitating a comprehensive examination of the urbanization process. By scrutinizing these indices, the study aims to unravel the intricate interplay between urban expansion, development, and its associated impacts. Through meticulous analysis, this research endeavors to shed light on both the positive contributions and the potential challenges arising from unchecked urbanization, offering insights crucial for informed decision-making and sustainable urban development strategies in Malappuram and similar contexts worldwide.

**Keywords:** Urbanization Effects, Geospatial Indices, Sentinel-2, Sustainable Growth, Societal Development

#### OBJECTIVES AND BACKGROUND

This study delves into the intricate dynamics of urbanization, realizing its dual nature encompassing both advantages and challenges. Focused on Malappuram, the research employs Sentinel-2 imagery, leveraging nine carefully selected indices such as NDBI (Kuc & Chormański, 2019), NBI, UI, BUI, BAEI, NBAI, NDCCI, BRBA, and MBAI. These indices serve as crucial metrics to extract urban built-up features, delivering a detailed analysis of urban development. The analysis seeks to solve the impact of unchecked over-urbanization by scrutinizing specific land-use classes, including built-up areas. The study aims to contribute valuable insights into the developing tapestry of societal progress and its implications for the chosen region (Bakirtas & Akpolat, 2018).

## METHODOLOGY

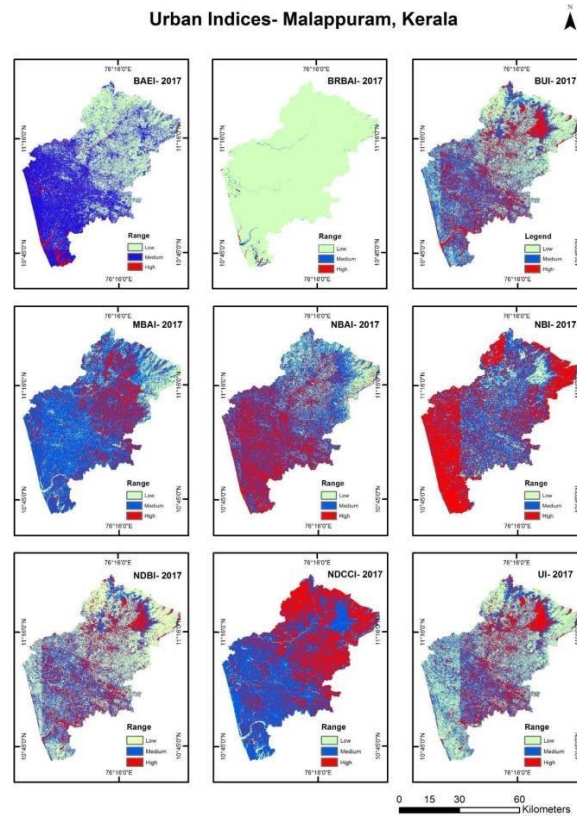
This study employs Sentinel-2 imagery to assess the impact of urbanization in Malappuram district. The methodology focuses on nine indices, which are NDBI (Zha et al., 2003), NBI, UI, BUI (He et al., 2010), BAEI Bouzekri et al. (2015), NBAI, NDCCI, BRBA, and MBAI (Waqar & Hussain, 2012). This comprehensive index selection aims to analyze specific urban land-use classes, providing a complete understanding of the effects of urbanization on the chosen study area. These geospatial indicators are derived from satellite bands through mathematical equations.

## RESULTS

Based on the assessment of the Sentinel-2 imagery, this study strategically employs the extraction of urban built-up features in Malappuram from 2017 to 2023. The results aim to unfold the consequences of urbanization on the selected study area. The study provides insights into the positive side of the urban boundary from Satellite bands and challenging facets by delineating major urban land-use classes through indices like NBAI, NDCCI, BRBA, and BAEI. This detailed analysis contributes to a holistic understanding of the effects of unchecked over-urbanization, guiding informed decisions for sustainable progress and growth in the complex tapestry of societal development.

**Table 2:** Low and High Range of All Indices

Name of Indices	Range 2017		Range 2020		Range 2023	
	Low	High	Low	High	Low	High
Normalized Difference Built-up Index (NDBI)	-0.91	0.82	-0.59	0.65	-0.45	0.52
New Built-up Index (NBI)	-5.42	1.30	-2.36	0.63	-2.33	0.54
Built Up Area Extraction Index (BAEI)	0.05	1.01	0.18	0.73	0.16	0.79
Normalized Built Up Area Index (NBAI)	0.98	1	0.99	1	0.99	1
Normalized Difference Concrete Condition Index (NDCCI)	-0.44	0.73	-0.30	0.59	-0.23	0.60
Urban Index (UI)	-0.83	0.72	-0.46	0.54	-0.45	0.52
Built-up Index (BUI)	-1.48	0.62	-1.04	0.59	-1.05	0.46
Band Ratio for Built-up Area (BRBA)	0.05	10.16	0.15	2.54	0.11	2.47
Modified Built up Area Index (MBAI)	638	191	316	416	319	270



**Figure 2: 2017 Urban Indices Range Value**

## CONCLUSION

In the rich tapestry of societal development, urbanization substantiates a double-edged force, bearing fruits of progress yet entwined with challenges. This study, centered on Malappuram, intricately dissects urban development using Sentinel-2 imagery, guided by nine indices. These indices reveal the urban landscape dynamics. Results uncover the impact, shedding light on the delicate balance between growth and challenges. This inclusive approach delineates major land- use classes and navigates urbanization merits and demerits, offering a valuable compass for steering toward sustainable and informed developmental trajectories.

## REFERENCES

1. Bakirtas, T., & Akpolat, A. G. (2018). The Relationship between Energy Consumption, Urbanization, and Economic Growth in New Emerging-Market Countries. *Energy*, 147, 110–121. <https://doi.org/10.1016/j.energy.2018.01.011>
2. Bouzekri, S., Lasbet, A. A., & Lachehab, A. (2015). A New Spectral Index for Extraction of Built-Up Area Using Landsat-8 Data. *Journal of the Indian Society of Remote Sensing*, 43(4), 867–873. <https://doi.org/10.1007/s12524-015-0460-6>
3. He, C., Shi, P., Xie, D., & Zhao, Y. (2010). Improving the Normalized Difference Built-Up Index to Map Urban Built-Up Areas Using a Semiautomatic Segmentation Approach. *Remote Sensing Letters*, 1(4), 213– 221.

<https://doi.org/10.1080/01431161.2010.481681>

4. Kuc, G., & Chormański, J. (2019). Sentinel-2 Imagery for Mapping and Monitoring Imperviousness in Urban Areas. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences – ISPR Archives*, 42(1/W2), 43–47. <https://doi.org/10.5194/isprs-archives-XLII-1-W2-43-2019>
5. Waqar, M. M., & Hussain, E. (2012). *Development of New Indices for Extraction of Built-Up Area and Bare Soil from Landsat*. <https://doi.org/10.4172/scientificreports.136>
6. Zha, Y., Gao, J., & Ni, S. (2003). Use of Normalized Difference Built-Up Index in Automatically Mapping Urban Areas from TM Imagery. *International Journal of Remote Sensing*, 24(3), 583– 594. <https://doi.org/10.1080/01431160304987>





NCCCSD-2024

CASCES – Department of Environmental Studies

ISBN 978-81-967107-0-5



9 788196 710705