International Institute for Applied Systems Analysis

IIASA

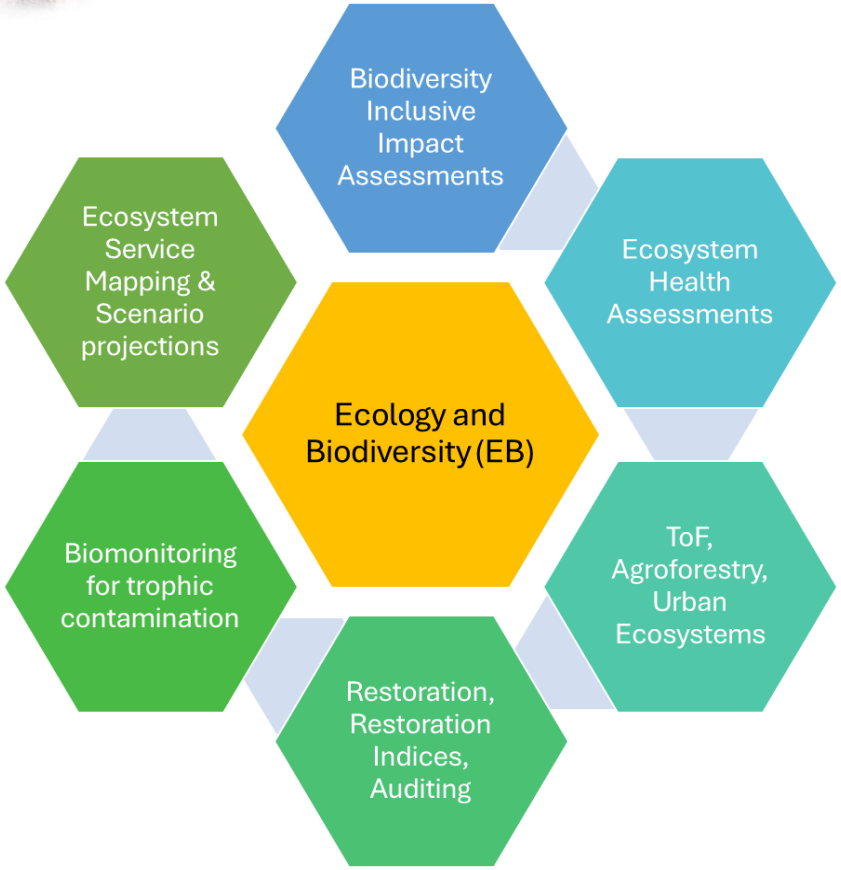
Socio-ecological interlinkages in Climate Risk Management

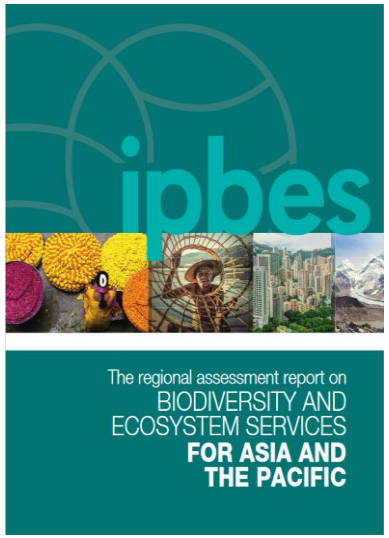
Hybridizing science and ILKS for Transformative Changes

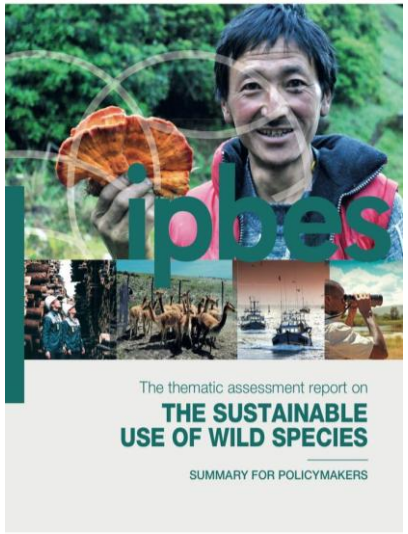
State-of-the-Art (SOTA) talks

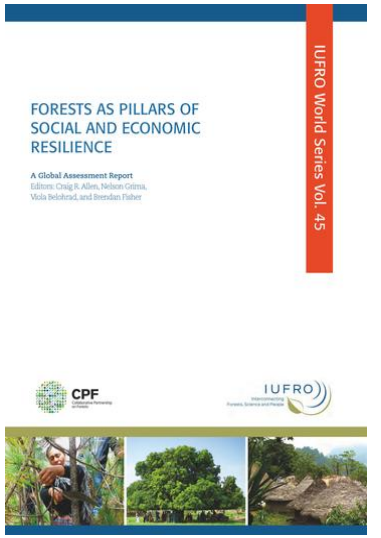
Shalini Dhyani

INQUIMUS 2025 Workshop on "Centering Justice in Climate Risk Management for Transformative Change"









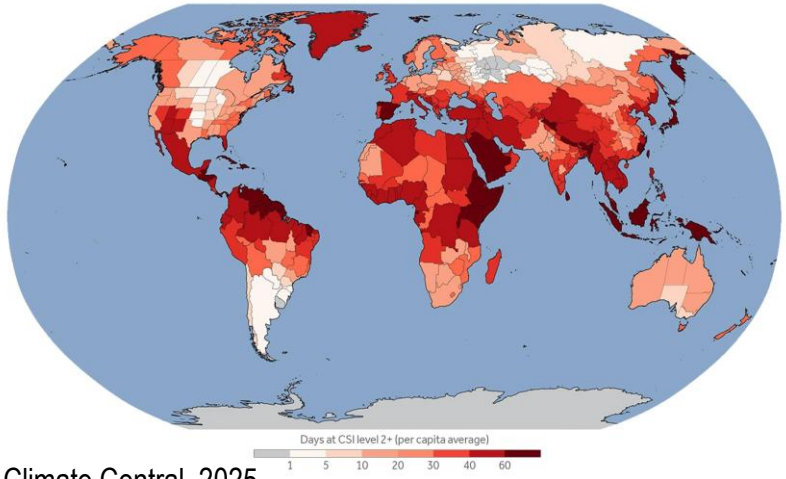
HKH Springshed Assessment
HKH Rangeland and Pastoralism

IPBES Second Global Assessment

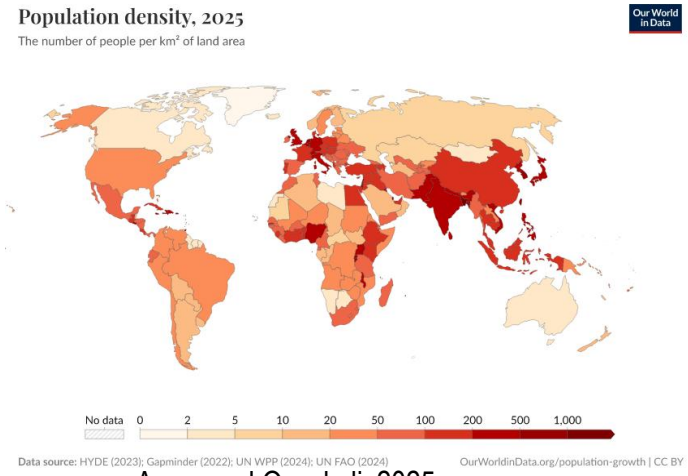
Qualitative, quantitative and mixed methods as well as tools, that includes field-based inventories, lab-based analysis followed by participatory approaches leveraging ILKS, RS/GIS, modelling as well as integration of science policy.

Why Climate Justice??

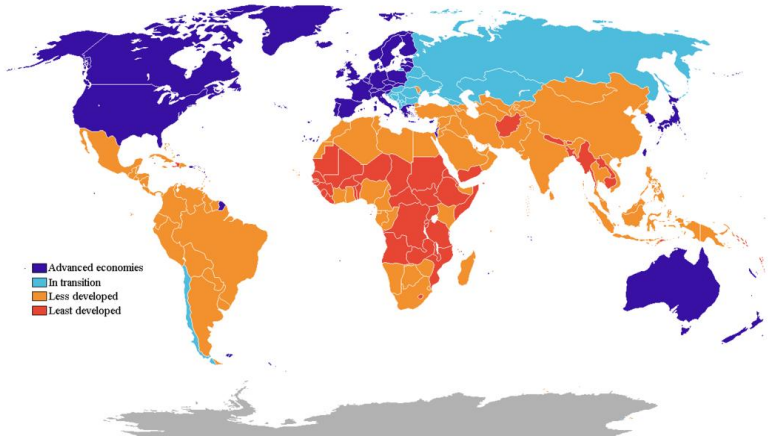
Disproportionate impacts, Inequality and systemic issues, Human rights, Historical responsibility, Just transition, Fairness in solutions



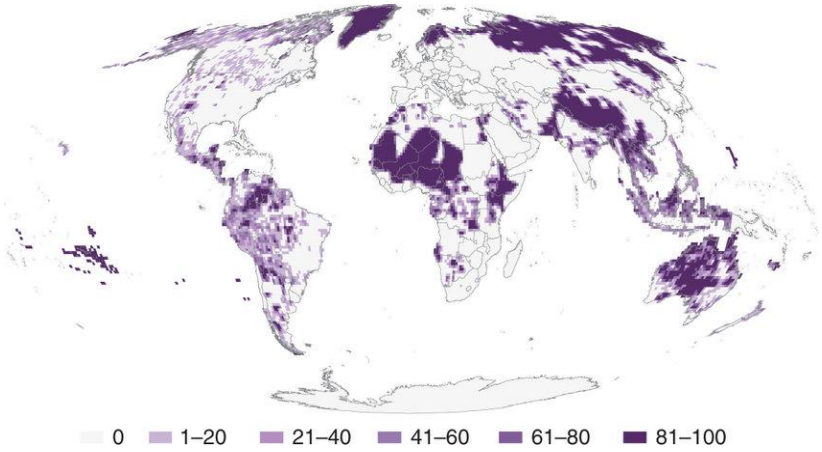
Climate Central, 2025



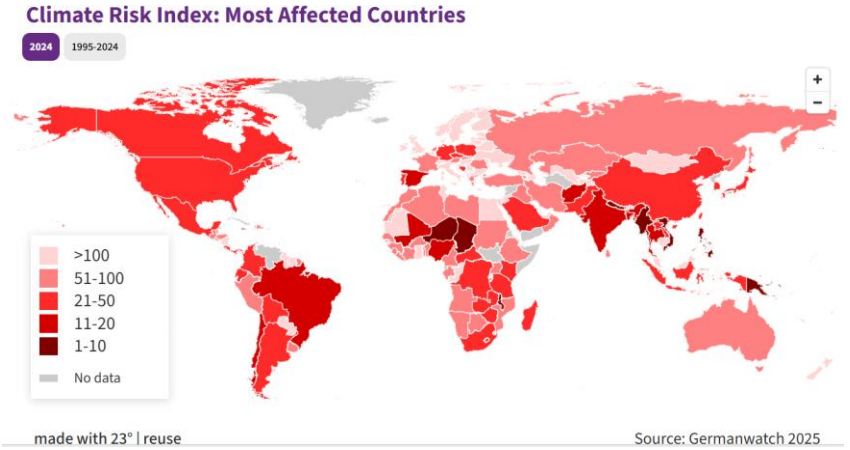
Acma and Ozyakali, 2025

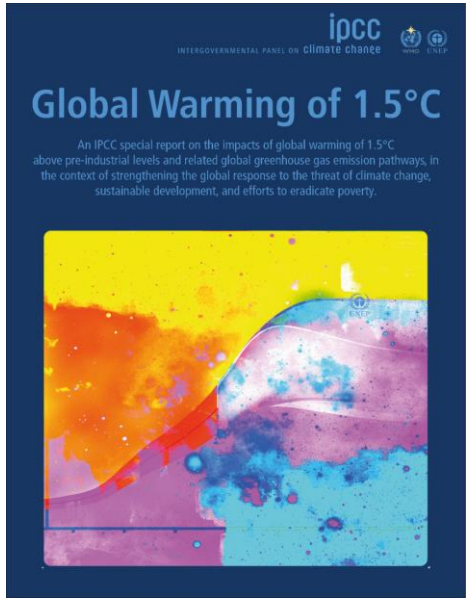


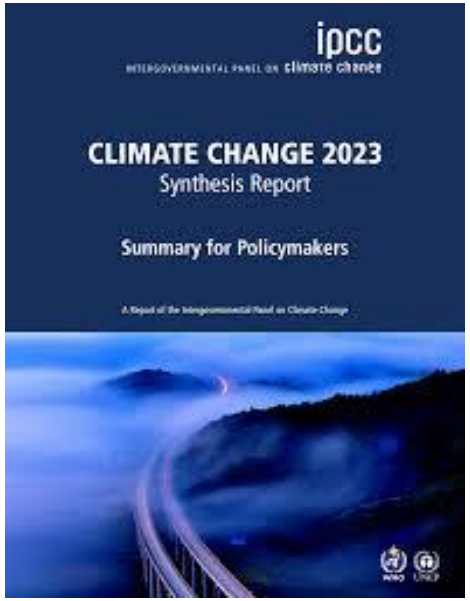
Wikimedia Commons

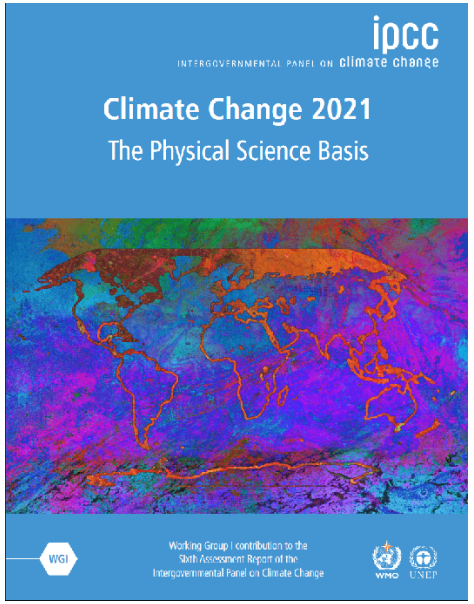


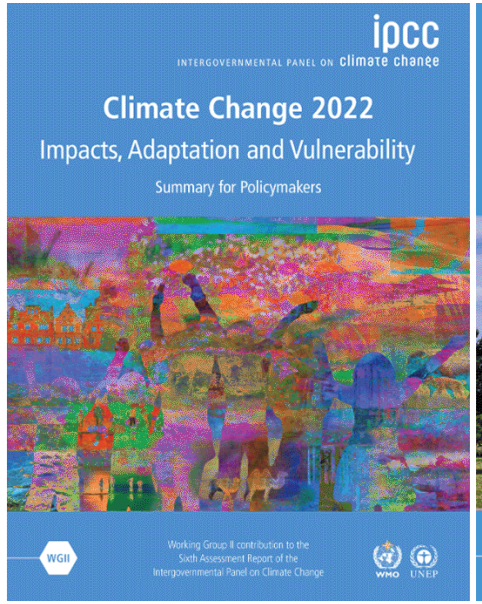
Garnett et al., 2018

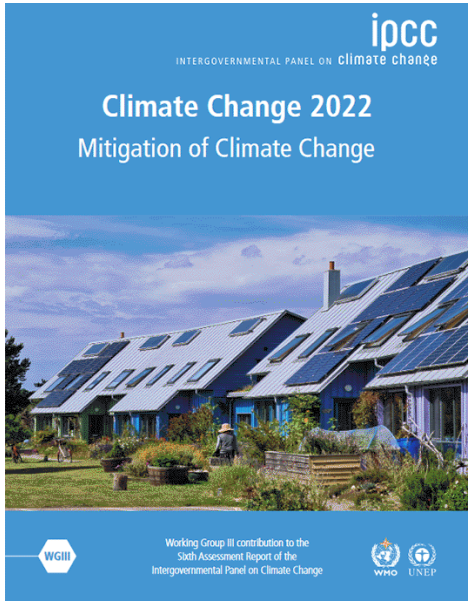


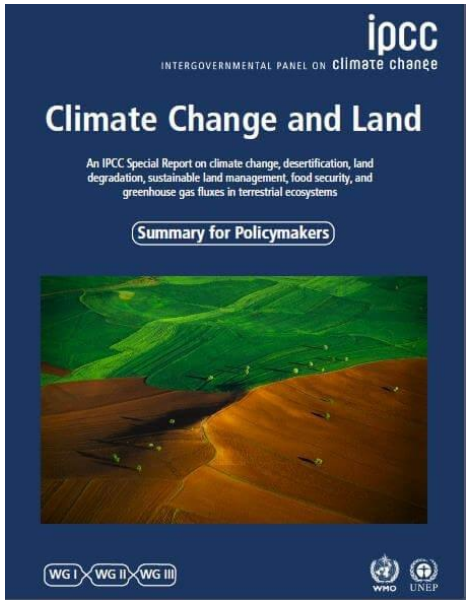

ipcc
INTERGOVERNMENTAL PANEL ON climate change
Global Warming of 1.5°C
An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

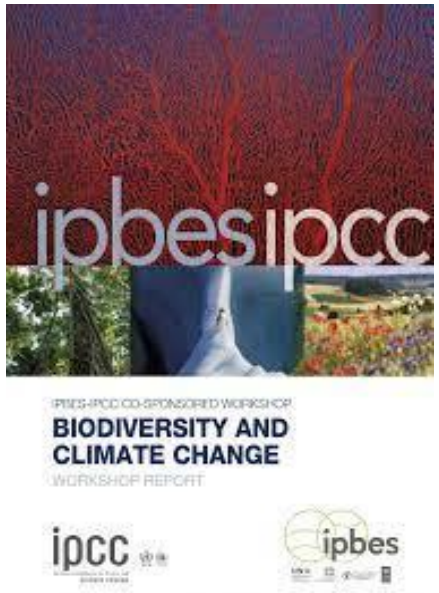

ipcc
INTERGOVERNMENTAL PANEL ON climate change
CLIMATE CHANGE 2023
Synthesis Report
Summary for Policymakers

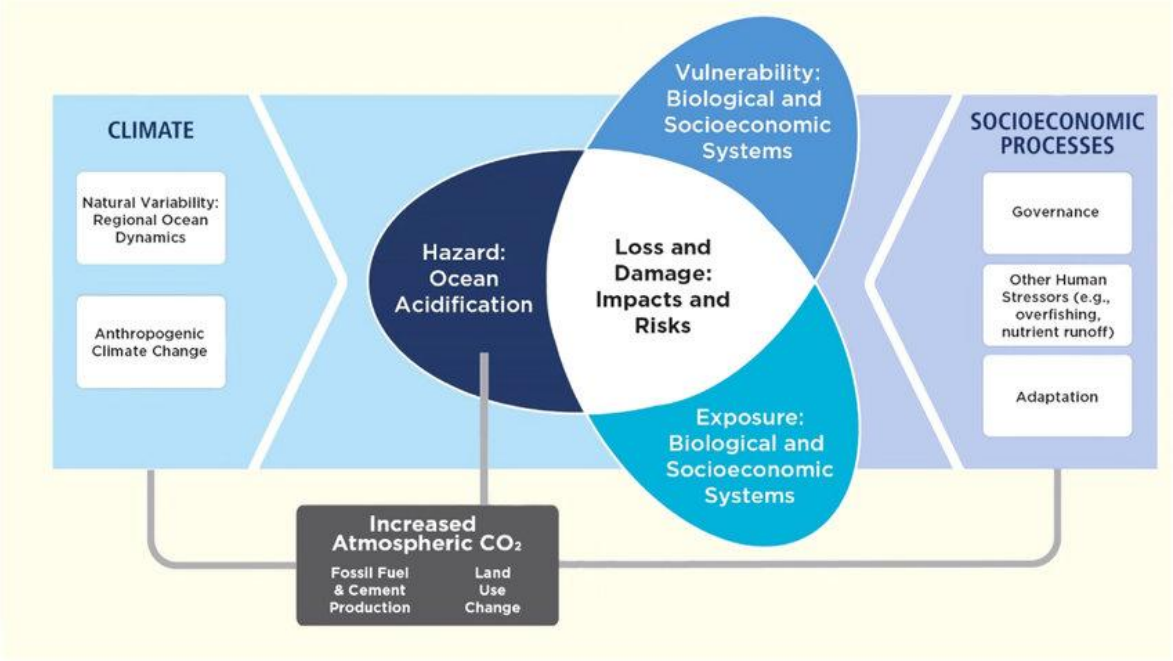

ipcc
INTERGOVERNMENTAL PANEL ON climate change
Climate Change 2021
The Physical Science Basis
WGI
Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change


ipcc
INTERGOVERNMENTAL PANEL ON climate change
Climate Change 2022
Impacts, Adaptation and Vulnerability
Summary for Policymakers
WGII
Working Group II contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change


ipcc
INTERGOVERNMENTAL PANEL ON climate change
Climate Change 2022
Mitigation of Climate Change
WGIII
Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change


ipcc
INTERGOVERNMENTAL PANEL ON climate change
Climate Change and Land
An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems
Summary for Policymakers
WG I
WG II
WG III


ipbes ipcc
IPBES-IPCC CO-SPONSORED WORKSHOP
BIODIVERSITY AND CLIMATE CHANGE
WORKSHOP REPORT
ipcc
ipbes


CLIMATE
Natural Variability: Regional Ocean Dynamics
Anthropogenic Climate Change
Hazard: Ocean Acidification
Vulnerability: Biological and Socioeconomic Systems
Loss and Damage: Impacts and Risks
Exposure: Biological and Socioeconomic Systems
SOCIOECONOMIC PROCESSES
Governance
Other Human Stressors (e.g., overfishing, nutrient runoff)
Adaptation
Increased Atmospheric CO_2
Fossil Fuel & Cement Production
Land Use Change

Growing relevance of healthy ecosystems, people centric approaches in climate adaptation and accelerating the momentum for transformative changes…

UNITED NATIONS DECADE ON ECOSYSTEM RESTORATION 2021-2030

Kunming - Montreal GLOBAL BIODIVERSITY FRAMEWORK

RED LIST OF ECOSYSTEMS

Convention on Biological Diversity

BONN CHALLENGE

RED LIST

Ramsar

Nature based Solutions The nature of progress

SUSTAINABLE DEVELOPMENT GOALS

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

IUCN

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

Sustainable Development Goals

ipbes Science and Policy for People and Nature

ipcc INTERGOVERNMENTAL PANEL ON climate change

CEM

COP30 AMAZÔNIA

Sendai Framework for Disaster Risk Reduction 2015 - 2030

Viewpoint | Published: 02 October 2023

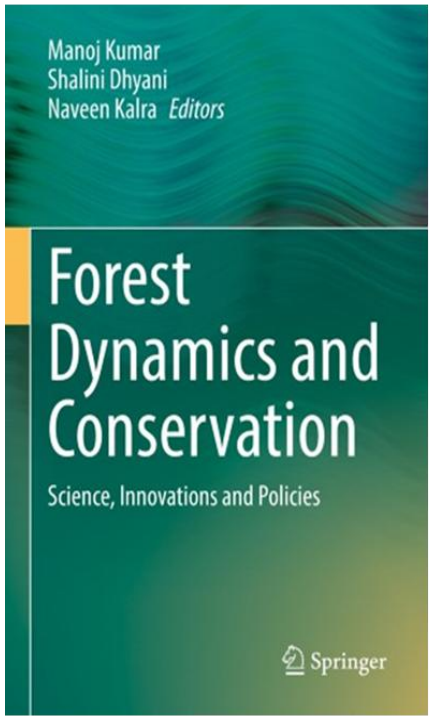
Priorities for progress towards Sustainable Development Goal 15 'Life on land'

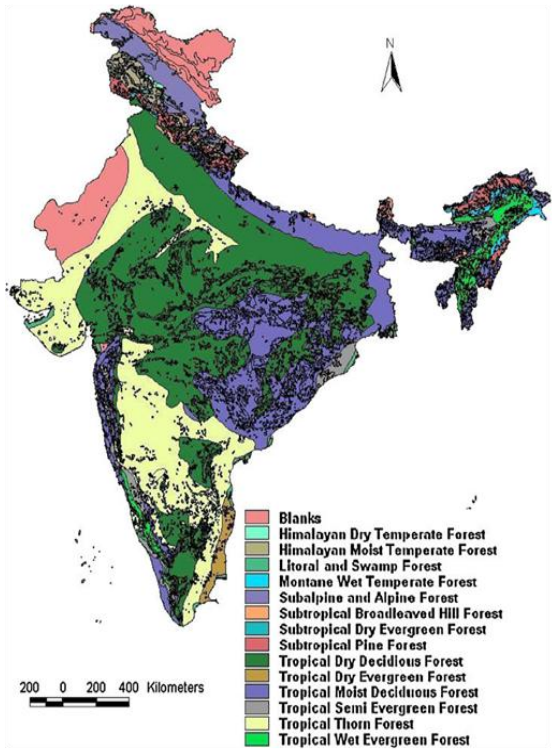
H. David Cooper, Musonda Mumba, Shalini Dhyani, Xiaoli Shen, Keping Ma, Rachel Wynberg, Sarah Laird & Jon Paul Rodríguez

Nature Ecology & Evolution **7**, 1570–1575 (2023) | Cite this article

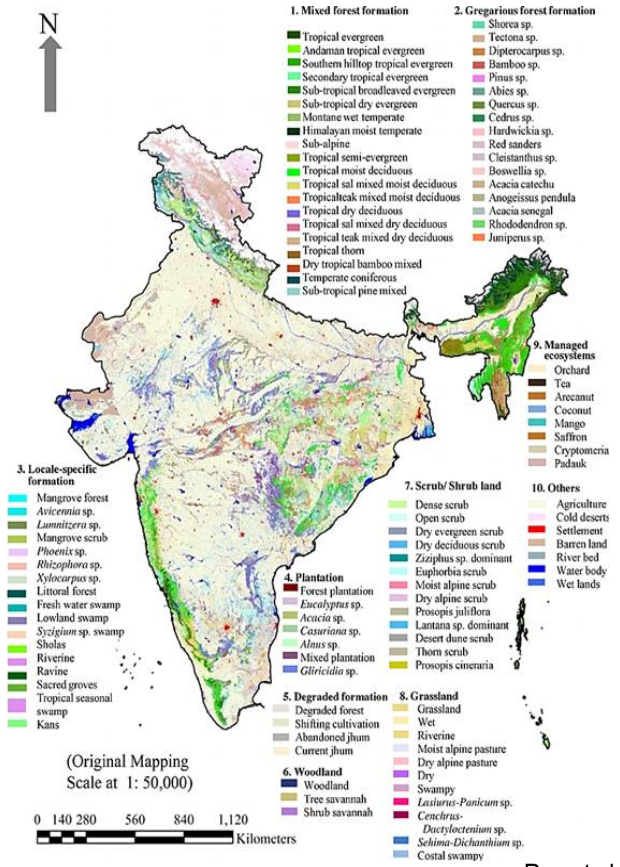
Leave No One Behind

Changes in Forest structure…rampant and profound…increasing loss and damage due to climate change is affecting marginalised as well IPLCs





Champion and Seth, 1968



Roy et al., 2015

- Largest and richest forest areas in the country are also home to the most marginalized communities in the region who facing the repercussions of climate change …
- Extreme weather and resource scarcity, are felt most by vulnerable communities who are least responsible for causing the problem.

Ecosystem resilience compromised due to diverse drivers including climate change

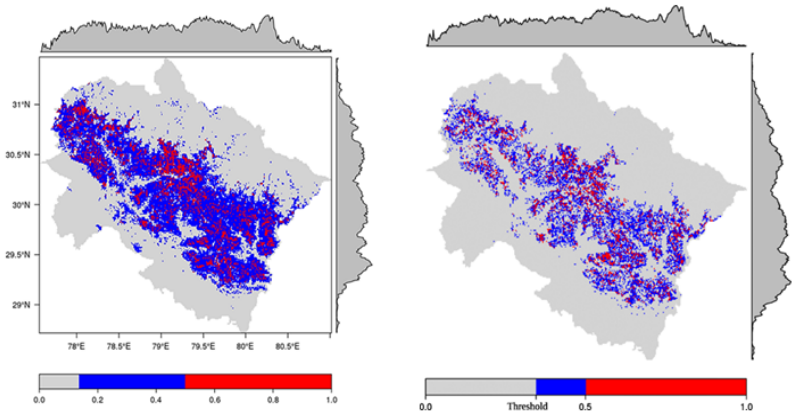
- Land degradation, extending over 96 million hectares is a primary ecological issue for India that has resulted in catastrophic biodiversity loss and exacerbated extreme weather occurrences.
- By 2050 climate change and land degradation, will result in US$1730 billion loss for India

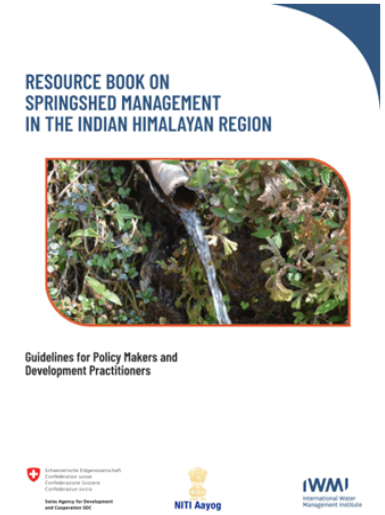
Pictures: Authors own

Ecosystem response to hydrological security by Central Himalayan Forests under changing climate

- Oak forests are hydraulic support to Indian Himalayan Region because of significant lower temperatures, high humidity supported by perennial streams inside them
- Oak forests having high carbon pool have vital contribution in conservation of soil, water, and numerous ecosystem services.
- Reduction and degradation of these forest is expected to alter the natural nitrogen cycle and hydrological balances that is apparent due to rapid depletion of natural spring-sheds

"90% of drinking water supply in Indian Himalayan Region is spring based supported by healthy Forests"





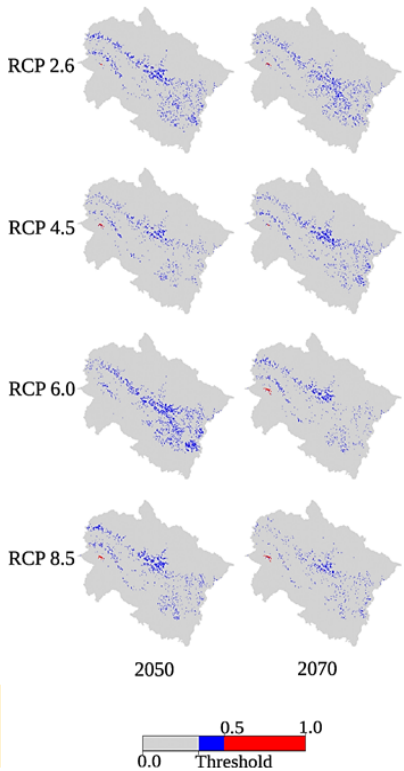
Ecosystem Classification: Global Ecosystem Functional Group, T2.1 Boreal and Temperate High Montane Forests and Woodlands

Regional Environmental Change (2020) 20: 113
https://doi.org/10.1007/s10113-020-01696-5

ORIGINAL ARTICLE

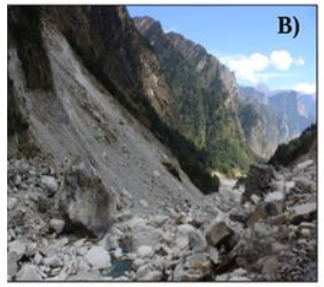
Predicting impacts of climate variability on Banj oak (*Quercus leucotrichophora* A. Camus) forests: understanding future implications for Central Himalayas

Shalini Dhyani[1] · Rakesh Kadaverugu[2] · Paras Pujari[1]



- High probable habitats (0.5-1) will decline and will almost vanished
- Potential habitats (threshold-1) show declining trends from RCP2.6 to RCP8.5 (20933 km^2 in present year to 4187 km^2)
- Potential habitats getting reduced by almost 80%
- The probable habitats will be scaled to higher altitudes (1754 to 2550 m amsl)
- Temperature seasonality (bio4) and altitude will influence future habitats

Riparian ecosystem health of river Ganga riparian buffers under climate change



- Riparian buffers of the Ganga have undergone significant deforestation resulting in enhanced pressure ecologically sensitive and fragile riparian buffer of the river Ganga.
- Significant loss of overall vegetation cover, i.e. 17.2% in the last decade (2008–2017) was observed.
- Vegetation assemblages are changing from climatic climax vegetation to pioneer species and enhanced invasion.

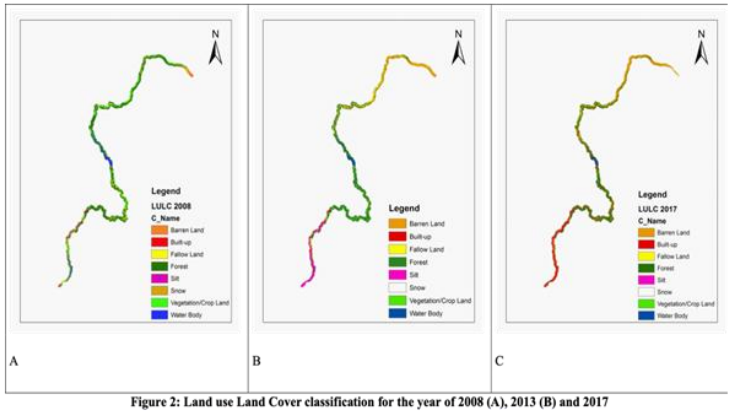
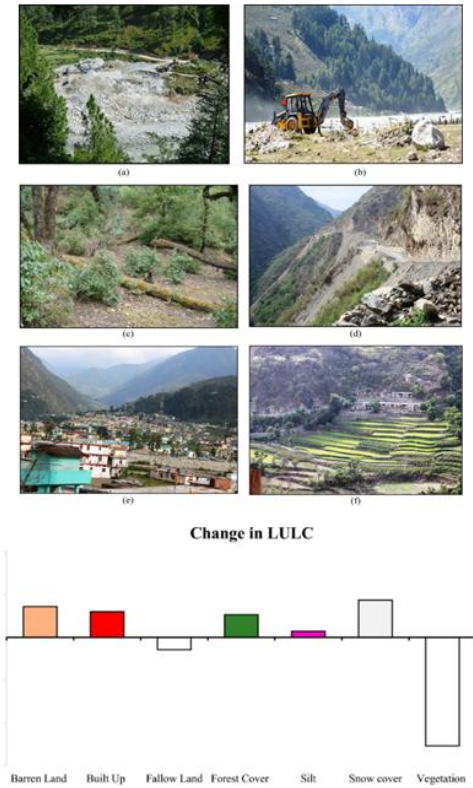
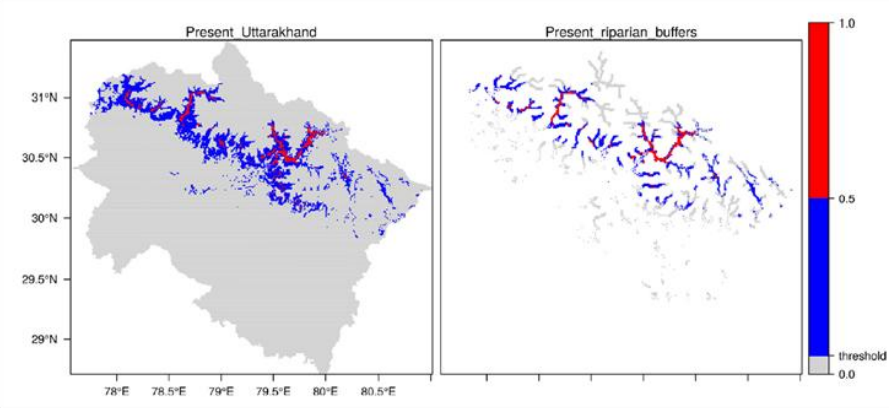


Figure 2: Land use Land Cover classification for the year of 2008 (A), 2013 (B) and 2017

An Integrated Eco-geospatial Approach for Assessment of Riparian Health in Upper Stretch of the Ganga, India

Original Article | Published: 15 May 2024





- Natural habitat of Seabuckthorn an indicator species of riparian health is continuously being degraded due to habitat destruction and harvesting.
- By the year 2050 the species will lose 87.2% (average of four RCPs) of the potential habitats
- By 2070 there is a marginal gain of 30 sq. km with respect to 2050, in the riparian buffers.
- 80.6% of the high probable habitat (0.5–1) will be lost by 2050, and 75.6% by 2070, in comparison with the present conditions

Our research highlights the urgent need for *in-situ* and *ex-situ* conservation to protect riparian buffers of river Ganga

Predicting impacts of climate variability on habitats of *Hippophae salicifolia* (D. Don) (Seabuckthorn) in Central Himalayas: Future challenges

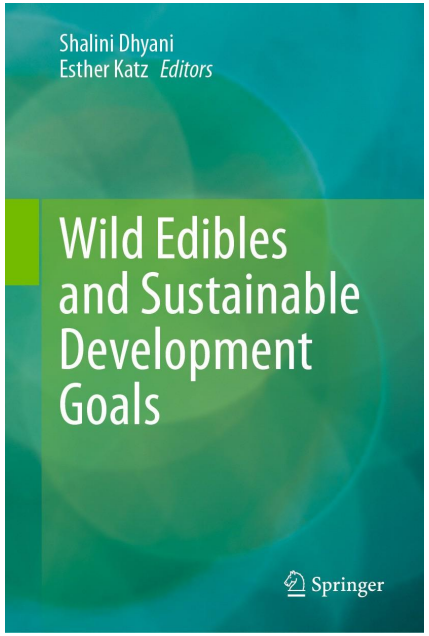
Shalini Dhyani[a,*], Rakesh Kadaverugu[b,*], Deepak Dhyani[c], Parikshit Verma[d], Paras Pujari[a]

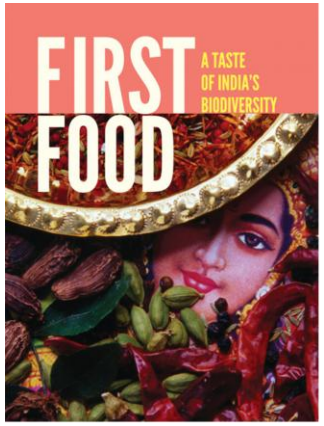
Centering Justice in Climate Risk Management for Transformative Change is required to address structural, socio-economic and intergeneration inequalities

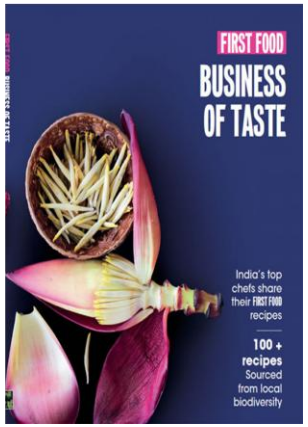
- India pledged to pursue the road of climate justice, protect the most vulnerable, and committed to achieving net-zero emissions by 2070.

Pictures: Authors own; Dhyani & Dhyani, 2016; Misra, 2008

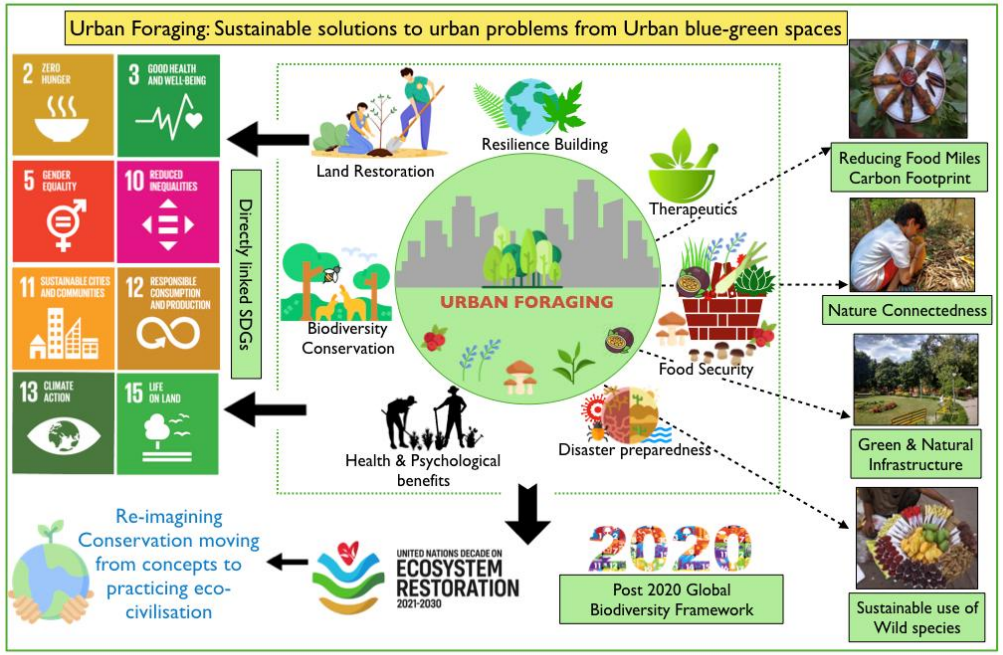
Centering Justice in Climate Risk Management is crucial…

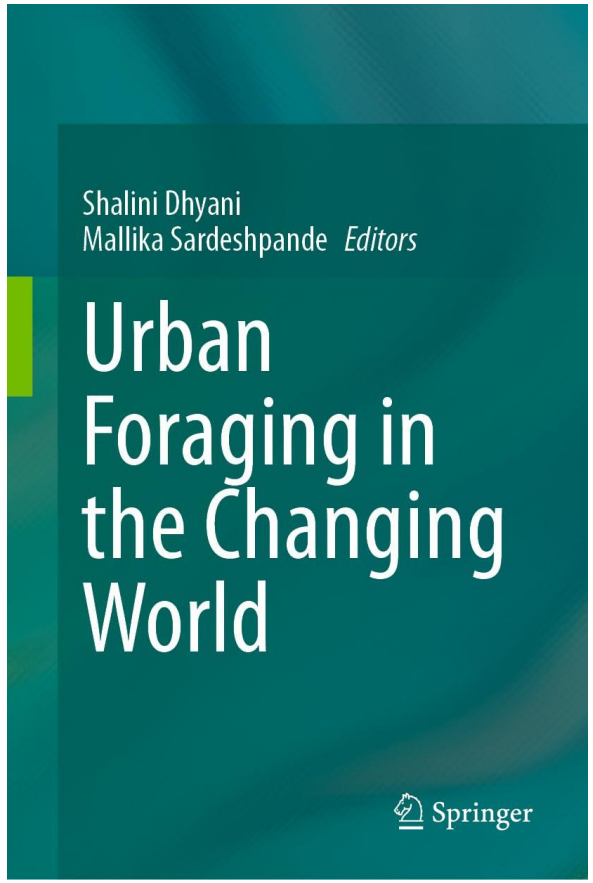






Centering Justice in Climate Risk Management is vital…



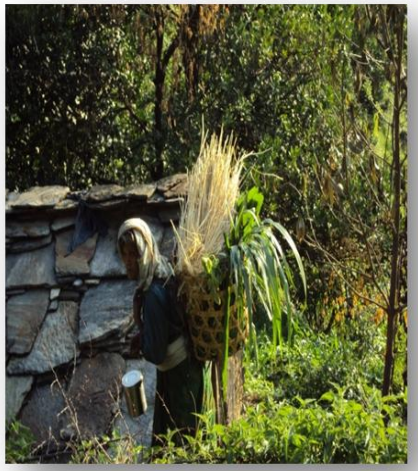


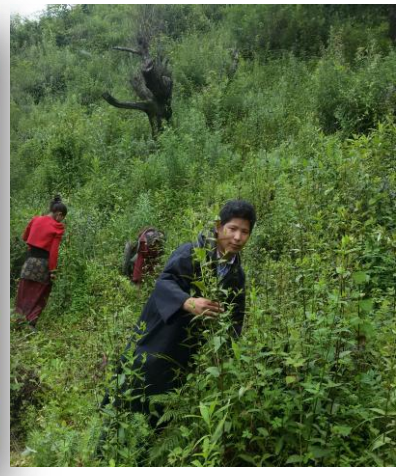
Socio-economic and Eco-biological Dimensions in Resource use and Conservation pp 31-60 | Cite as

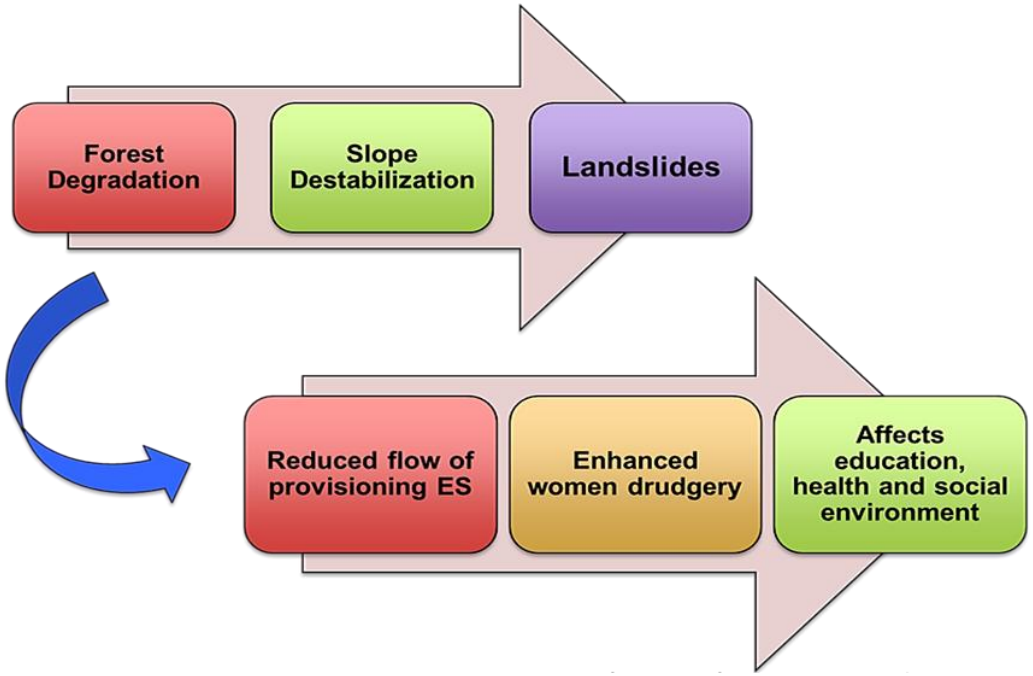
Local Socio-Economic Dynamics Shaping Forest Ecosystems in Central Himalayas

Authors Authors and affiliations

Shalini Dhyani ✉, Deepak Dhyani







- Climate justice is needed because the negative impacts of climate change,
- Promote solutions that are equitable, address the root causes of climate change and social injustices, and ensure that the burdens and benefits of climate action are shared fairly.
- Climate justice also recognizes that a healthy environment is a human right and seeks to protect the rights of future generations.

Depopulation in Himalayas: Growing Ghost Villages

Uttarakhand has over 1,700 uninhabited villages in 2025 among 16,793 villages

ICM
INDIA CENTRE FOR MIGRATION

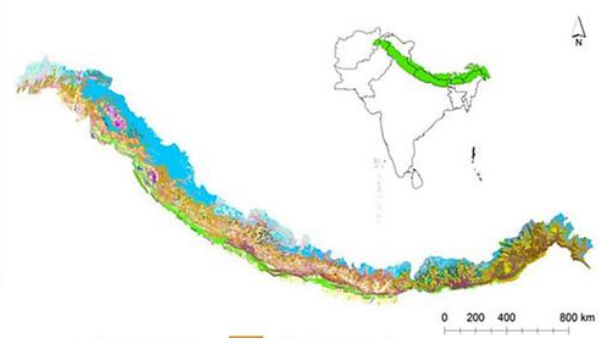
LDD Land Degradation & Development

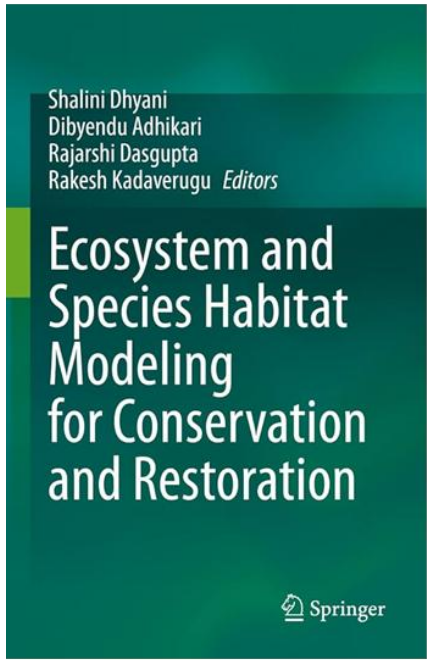
RESEARCH ARTICLE

Exploring synergies between India's climate change and land degradation targets: Lessons from the Glasgow Climate COP

Shalini Dhyani, Harini Santhanam, Rajarshi Dasgupta, Dhanya Bhaskar, Indu K. Murthy, Kripal Singh

First published: 03 September 2022 | https://doi.org/10.1002/ldr.4452 | Citations: 23





Biodiversity and Conservation (2023) 32:3731–3764
https://doi.org/10.1007/s10531-023-02692-x

REVIEW PAPER

Are Himalayan ecosystems facing hidden collapse? Assessing the drivers and impacts of change to aid conservation, restoration and conflict resolution challenges

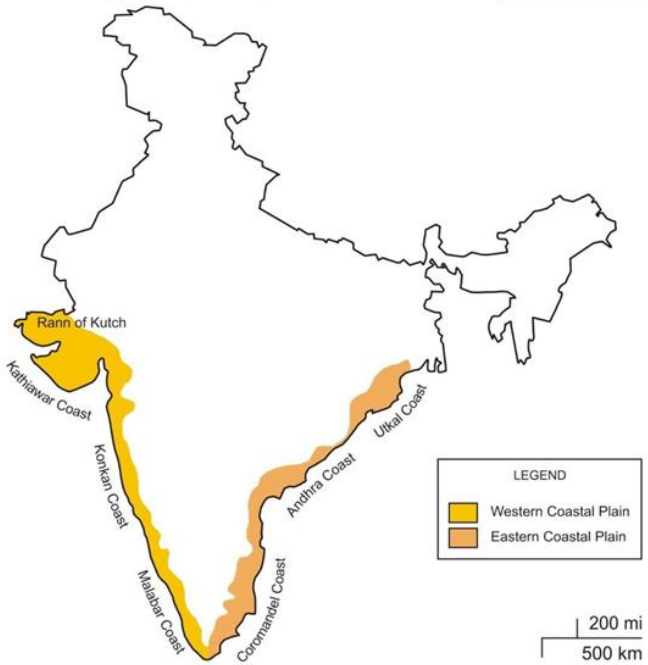
Shalini Dhyani[1,2]

Anthropocene Science
https://doi.org/10.1007/s44177-024-00074-8

OPINION PAPER

Ecosystem Health Assessment in India for Mainstreaming Global Biodiversity Framework Headline Indicator and Prioritising Conservation Action

Shalini Dhyani[1,9] · Deepu Sivadas[2,9] · Rajiv Chaturvedi[3,9] · Amrita Neelakantan[4,9] · Sonali Ghosh[5,9] · Sarala Khaling[6,9] · Simran Sharma[3] · Dhritiman Das[7,9] · Rajarshi Dasgupta[8,9]



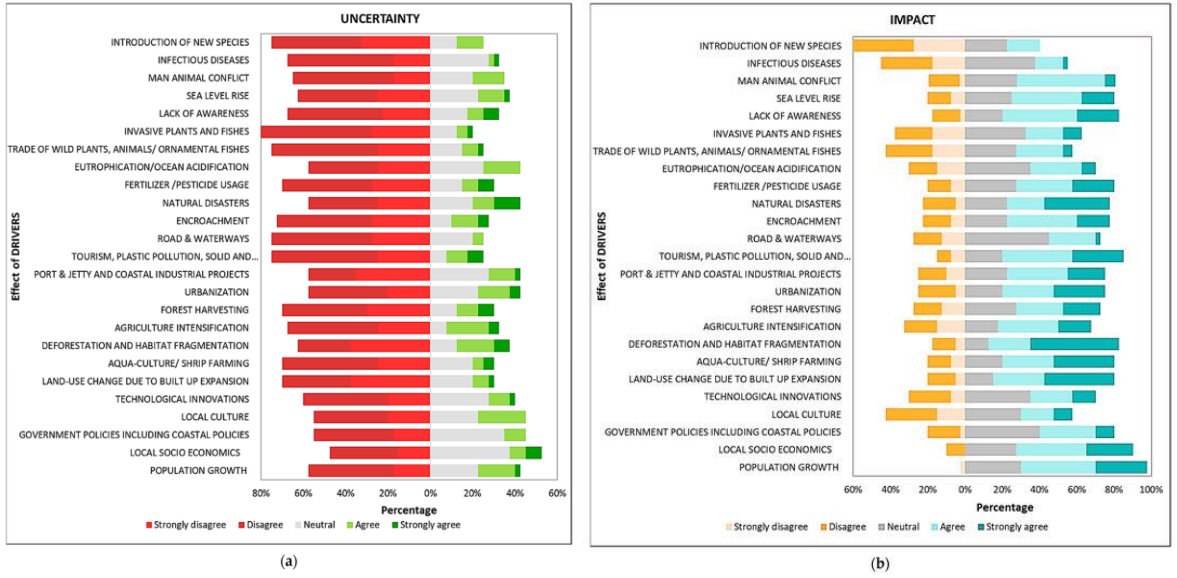
Centering justice in climate risk management involves integrating equity into decision-making processes to create transformative change by addressing how climate change disproportionately affects vulnerable groups.

Involving communities, to assess the values, risks for projecting realistic scenarios…

Open Access Article

Participatory Stakeholder Assessment for Drivers of Mangrove Loss to Prioritize Evidence-Based Conservation and Restoration in Bhitarkanika and Mahanadi Delta, India

by Shalini Dhyani [1,*], Jayshree Shukla [1], Rakesh Kadaverugu [1], Rajarshi Dasgupta [2,*], Muktipada Panda [3], Sudip Kumar Kundu [4], Harini Santhanam [4], Paras R. Pujari [1], Pankaj Kumar [2] and Shizuka Hashimoto [2]



Ocean & Coastal Management
Volume 264, May 2025, 107626

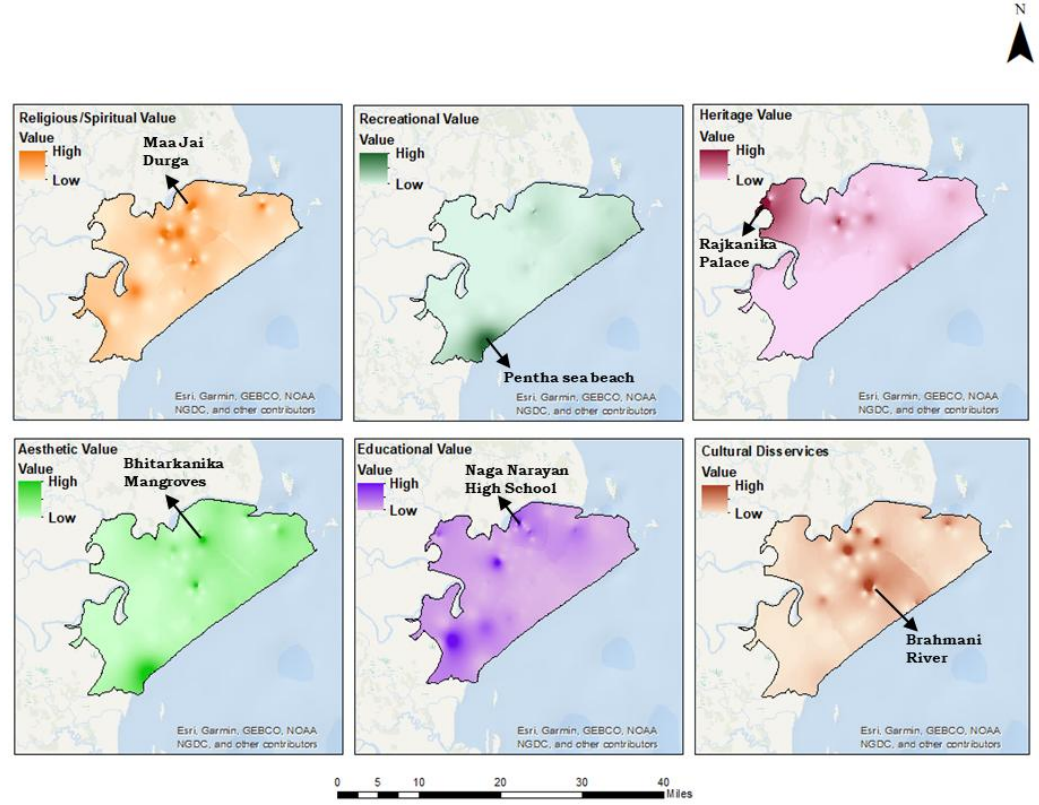
Relevance of community perceptions in mapping cultural ecosystem services: Lessons from bio-cultural landscape of Bhitarkanika Wildlife Sanctuary, Odisha

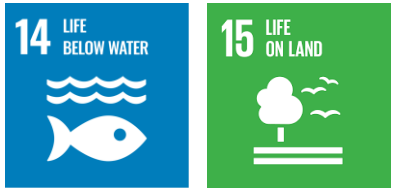
Rupali Nayal [a], Manu Thomas [a], Anuj Kumar Tripathi [a], Kusum Jaswal [b], Rajarshi Dasgupta [c], Shizuka Hashimoto [d], Shalini Dhyani [a]

Journal for Nature Conservation
Volume 87, September 2025, 126988

Relationships between Nature's Contributions to People, drivers of change, and landscape values in a Biocultural Landscape, the Himalayas

Radhika Sood [a b], Somidh Saha [c d], Shalini Dhyani [a b]





From FPIC to Consensus for trust building, avoiding tokenistic approach and inculcating sense of responsibility and belongingness….

Free, Prior, and Informed Consent (FPIC)




CONSENSUS

4 QUALITY EDUCATION

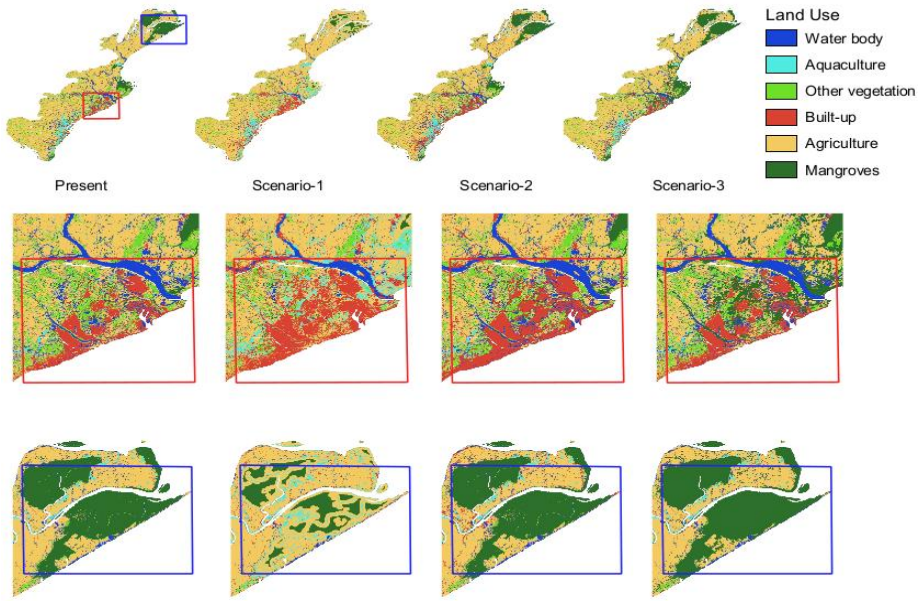
10 REDUCED INEQUALITIES

Journal of Coastal Conservation (2022) 26:30
https://doi.org/10.1007/s11852-022-00877-0

Scenario-based quantification of land-use changes and its impacts on ecosystem services: A case of Bhitarkanika mangrove area, Odisha, India

Rakesh Kadaverugu[1] · Shalini Dhyani[1] · Vigna Purohit[1] · Rajarshi Dasgupta[2] · Pankaj Kumar[2] · Shizuka Hashimoto[2,3] · Paras Pujari[1] · Rajesh Biniwale[1]

Received: 24 February 2022 / Revised: 14 June 2022 / Accepted: 14 June 2022



Case study

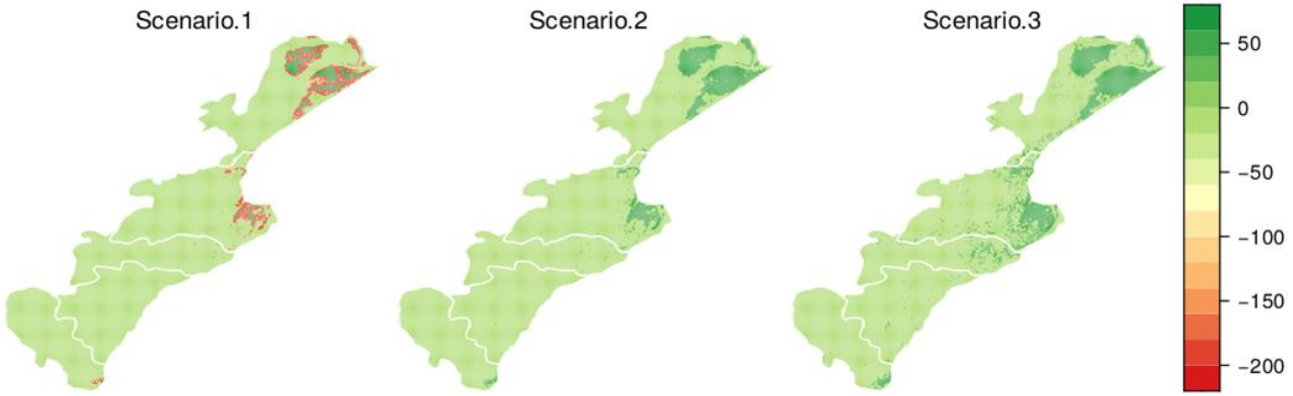
APN Science Bulletin
2024, Volume 14, Issue 1, 17–27, e-ISSN 2522-7971

Plausible alternative future of mangroves and their ecosystem services: Case studies from Asia-Pacific region

Shizuka Hashimoto[a,h*], Rajarshi Dasgupta[a], Osamu Saito[a], Brian Alan Johnson[a], Yasuo Takahashi[a], Pankaj Kumar[a], Takehito Yoshida[b], Wanhui Huang[b], Vinod B. Mathur[c], Goutam Talukdar[c], Sonali Ghosh[c], Anukul Nath[c], Chitiz Joshi[c], Paras Pujari[d], Shalini Dhyani[d], Rakesh Kadaverugu[d], Lipei Peng[e], Damasa Macandog[f], Apolosa Robaigau[g]

[a] Institute for Global Environmental Strategies, Hayama, Japan
[b] Research Institute for Humanities and Nature, Kyoto, Japan
[c] Wildlife Institute of India, Dehradun, India
[d] National Environmental Engineering Research Institute, Nagpur, India
[e] National Taiwan University, Taiwan
[f] University of the Philippines, Los Baños,

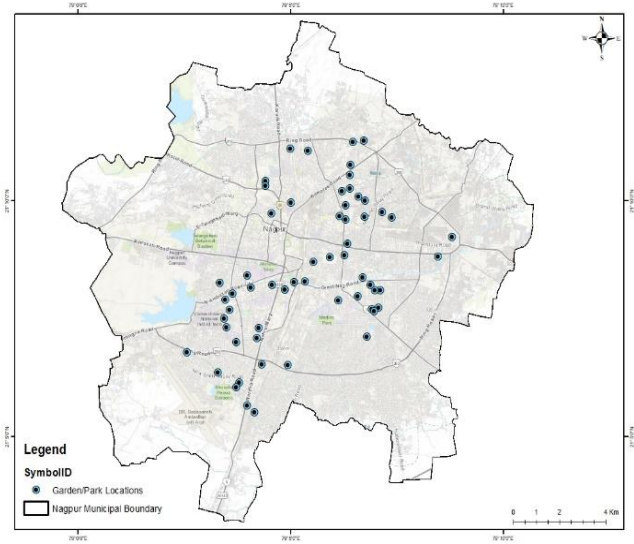
ABSTRACT
Over the past few decades, scenario analysis emerged as a useful tool for environmental decision-making amidst multiple uncertainties. Using the influential drivers of change, scenarios portray the range of plausible alternative futures useful for quantifying the synergies and trade-offs of vital ecosystem services across multiple develop-

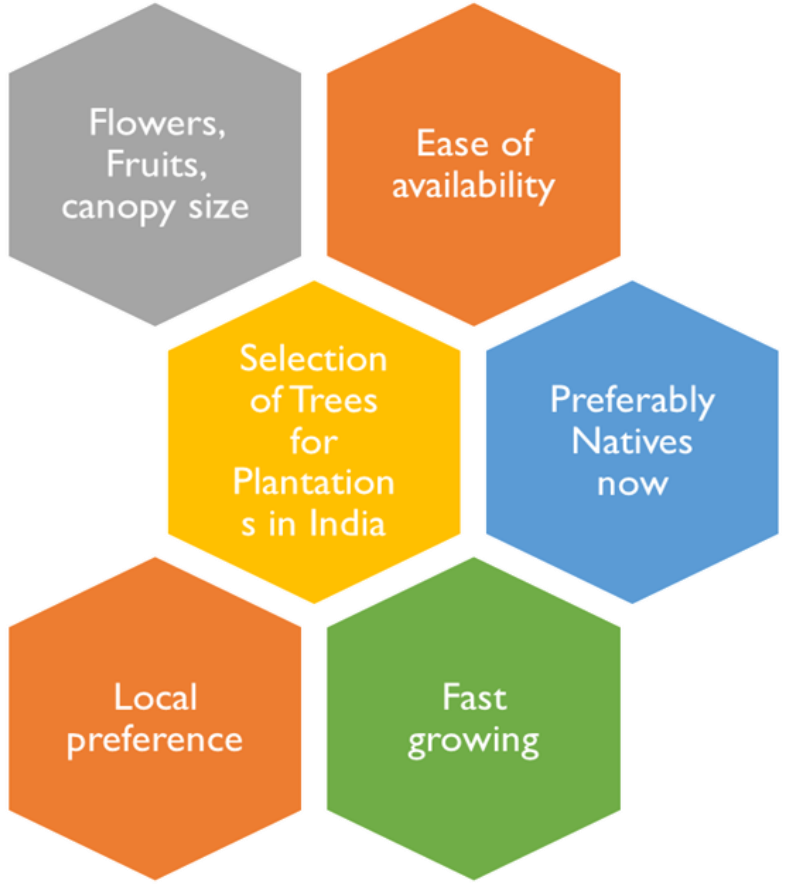


Priorities for understanding not only relevance of nature but its timely integration for human well-being

Rigorous sampling and data collection followed by interactive participatory approaches and citizen science

Participatory survey with +1500 respondents



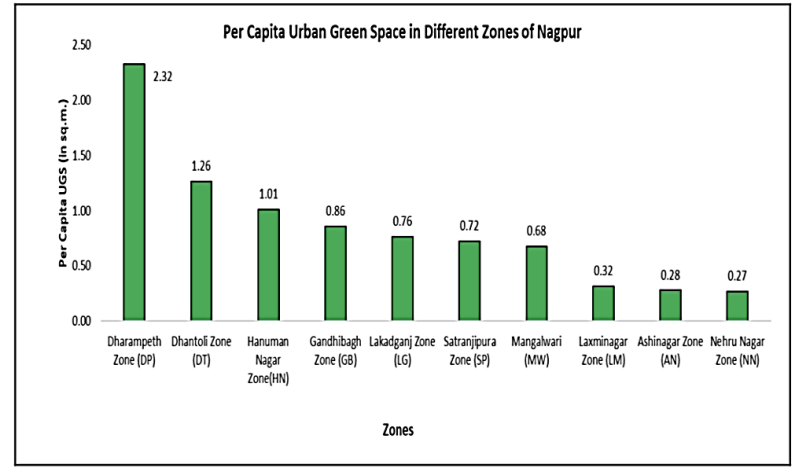


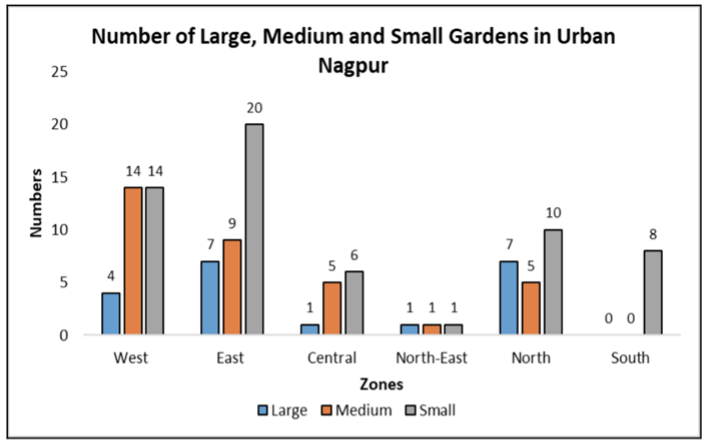
Data collection from 70+ parks, gardens and playgrounds

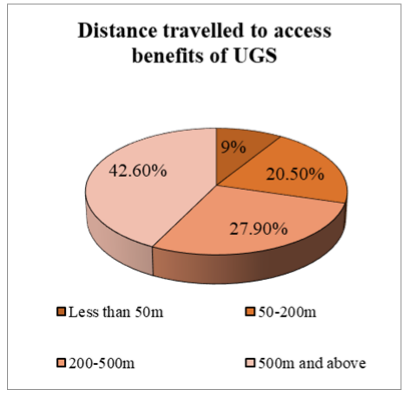
Per capita UGS requirement for good quality of life

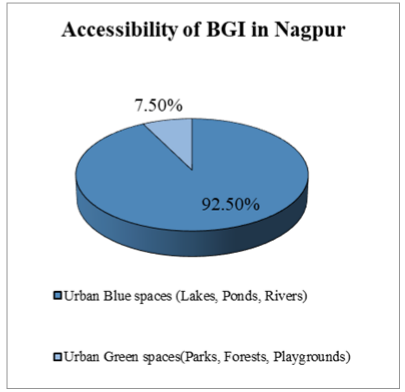
World Health Organization (WHO) recommends minimum of **9 m^2 of green space** per individual with an ideal UGS value of 50 m^2 per capita.

Per capita UGS distribution (10 -12 m^2 per-capita green space) in different zones of Urban Nagpur as per URDPFI, 2015









Open Access Article

3-30-300 Benchmark: An Evaluation of Tree Visibility, Canopy Cover, and Green Space Access in Nagpur, India

by Shruti Ashish Lahoti [1,*], Manu Thomas [2], Prajakta Pimpalshende [2,3], Shalini Dhyani [2,*], Mesfin Sahle [1], Pankaj Kumar [1] and Osamu Saito [1]

Earth Observation in Urban Monitoring
Techniques and Challenges
Earth Observation
2024, Pages 359-374

Chapter 17 - Shrinking urban green spaces, increasing vulnerability: solving the conundrum of the demand-supply gap in an urbanizing city

Jayshree Shukla [1], Shalini Dhyani [2] *, Soumya Chakraborty [3], Saptarshi Dutta Purkayastha [1], Ramesh Janipella [1], Paras Pujari [1], Atya Kapley [4]

Dhyani et al., 2018; Shukla et al., 2024; Lahoti et al., 2025

Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdrr

Governing green change to improve resilience by assessing urban risks for localizing nature based solutions in fast sprawling Dehradun, India

Manu Thomas [a], Athira Prakash [a], Shalini Dhyani [a, b, *], Paras R. Pujari [a, b]

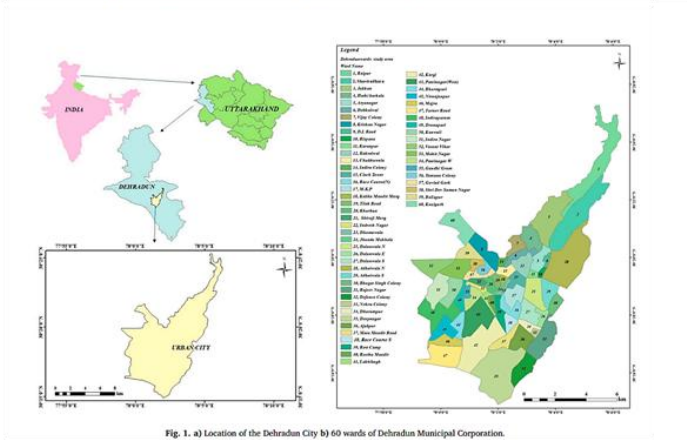
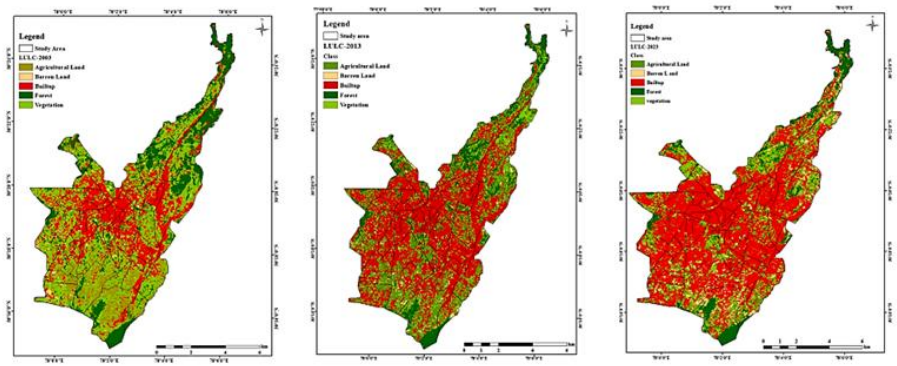
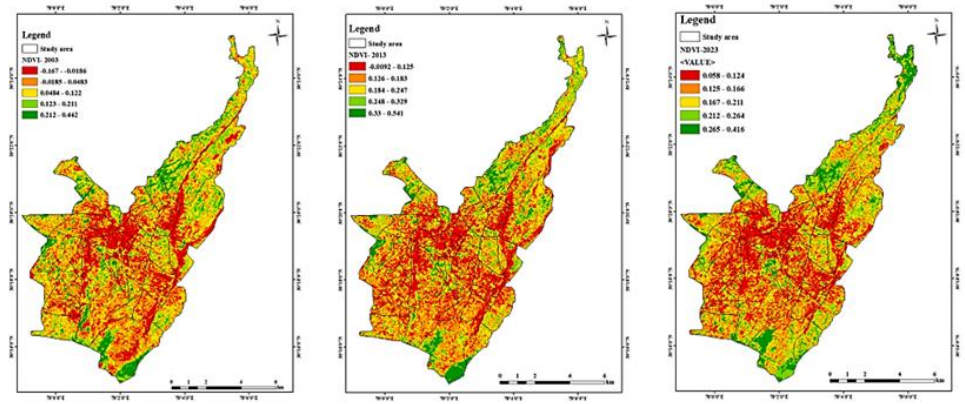


Fig. 1. a) Location of the Dehradun City b) 60 wards of Dehradun Municipal Corporation.



a)2003 b)2013 c)2023

Fig. 4. Decadal changes in LULC for the city of Dehradun.



a)2003 b)2013 c)2023

Fig. 6. Decadal changes in NDVI for the city of Dehradun (a, b, c).

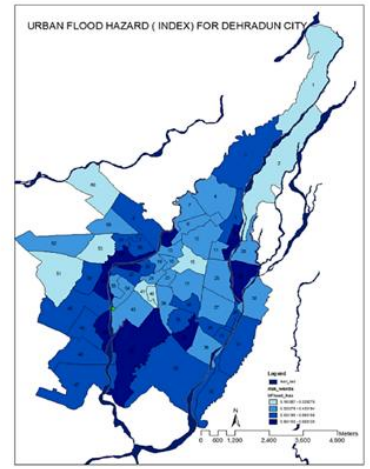
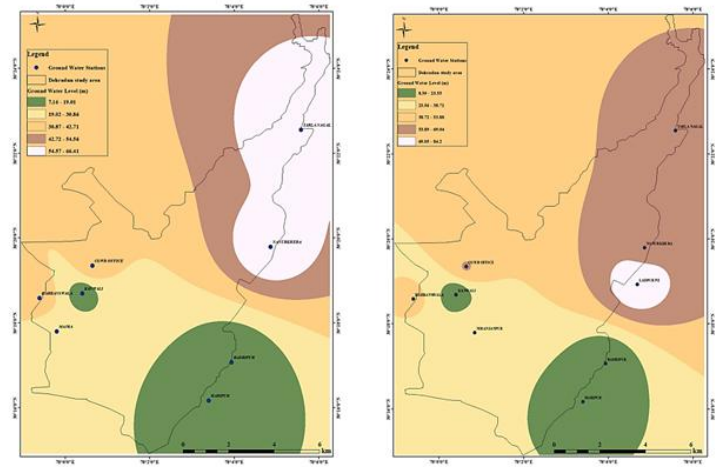


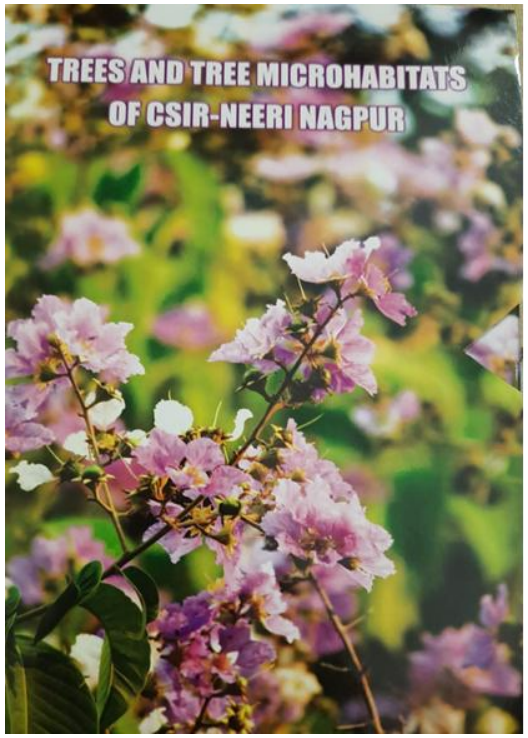
Fig. 11. Ward wise Urban Flood Hazard Index of the study area (Source: 26).

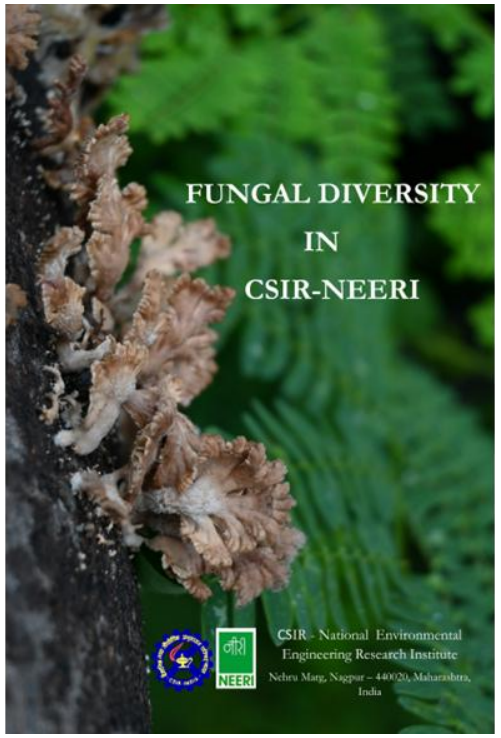


a)2012 b)2022

Fig. 9. Interpolated Groundwater level for the city of Dehradun.

Capacity Building and outreach





Our work stresses on the priorities for integrating biophysical, socio-ecological and science-policy aspects for transformative changes to addressing climate risk management

- Absence of efforts could result in further deterioration of ecosystems, affecting NCPs and long-term loss and damage
- The global actions to adapt and mitigate climate impacts cannot be realized unless supported by local actions.

LETTER • OPEN ACCESS

How do trees outside forests contribute to human wellbeing? A systematic review from South Asia

Pooja Choksi*, Dhwani Lalai, Anamika Menon, Abha Joglekar, Anirban Roy, Vijay Ramprasad, Mahendra Singh Thapa, Ravikanth Gudasalamani, Shalini Dhyani, Milind Bunyan Show full author list

Published 28 February 2025 • © 2025 The Author(s). Published by IOP Publishing Ltd

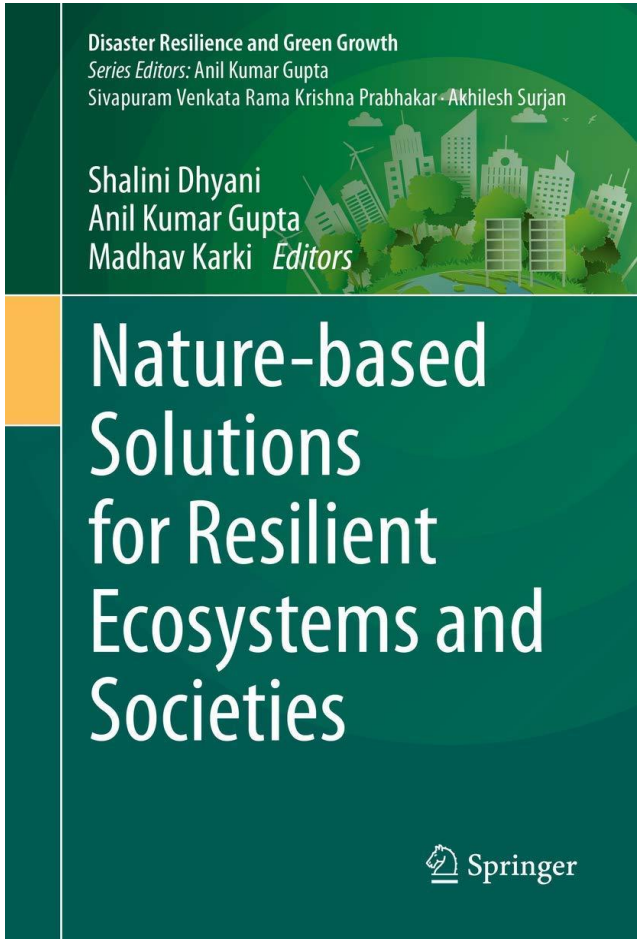
Environmental Research Letters, Volume 20, Number 3

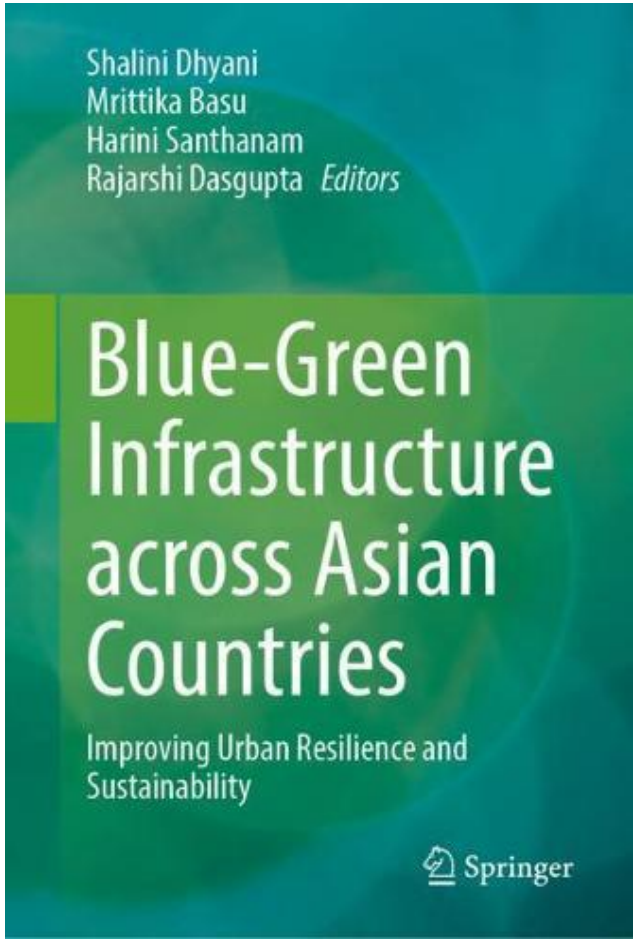
Focus on Land Use Cover Changes and Synthesis in South and South East Asia

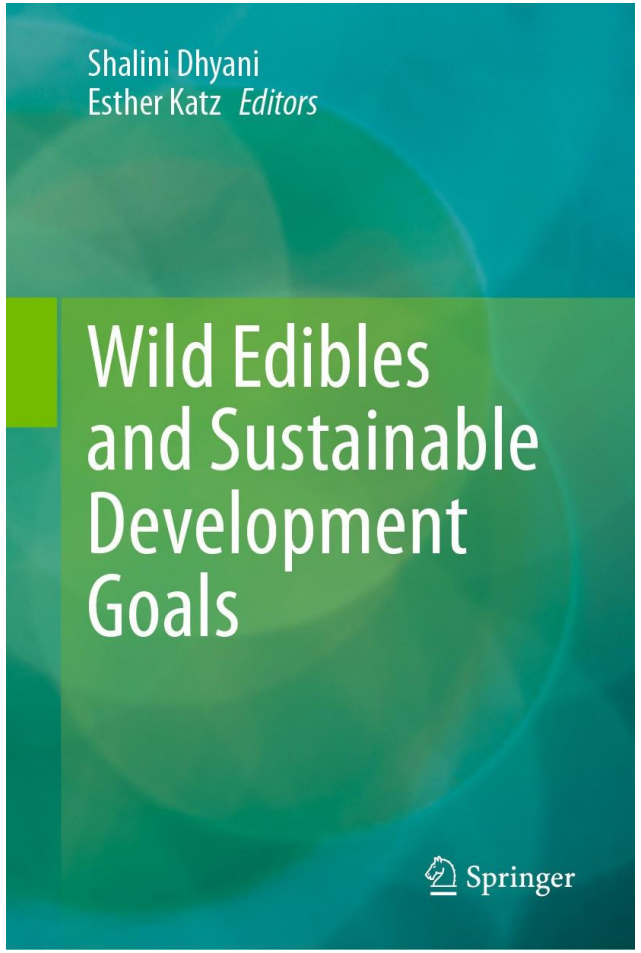
Open Access Review

Agroforestry to Achieve Global Climate Adaptation and Mitigation Targets: Are South Asian Countries Sufficiently Prepared?

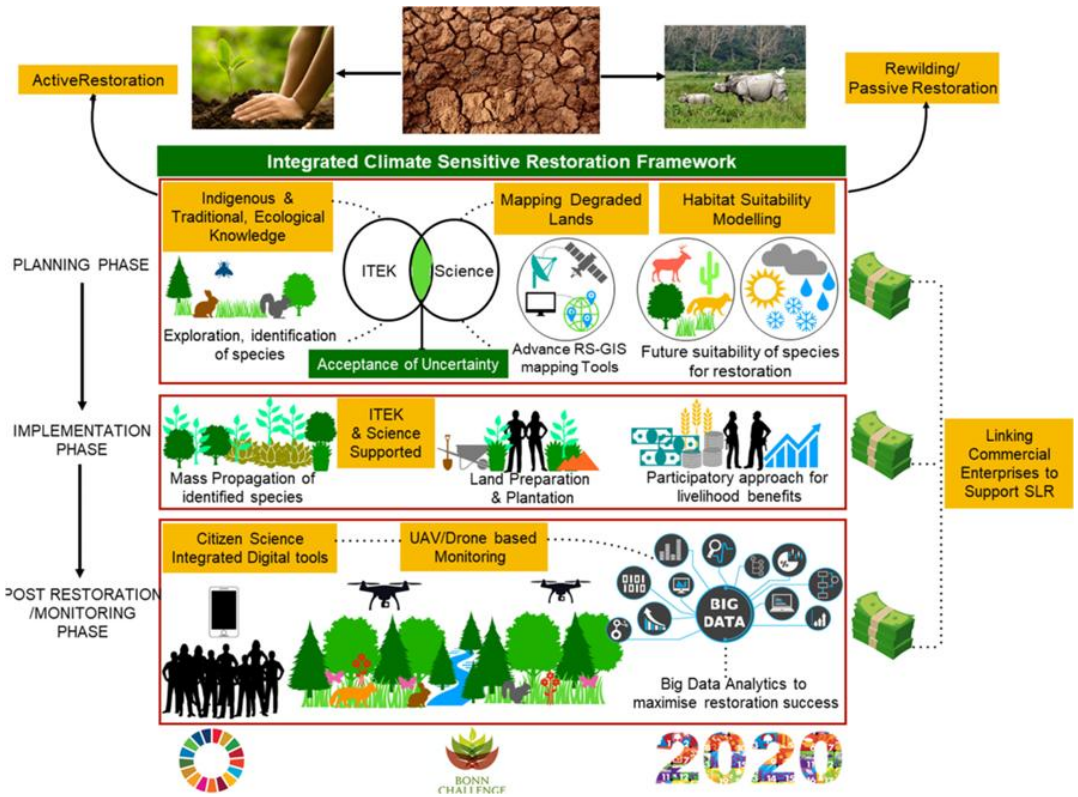
by **Shalini Dhyani** [1,*], **Indu K Murthy** [2], **Rakesh Kadaverugu** [3], **Rajarshi Dasgupta** [4], **Manoj Kumar** [5] and **Kritika Adesh Gadpayle** [2]

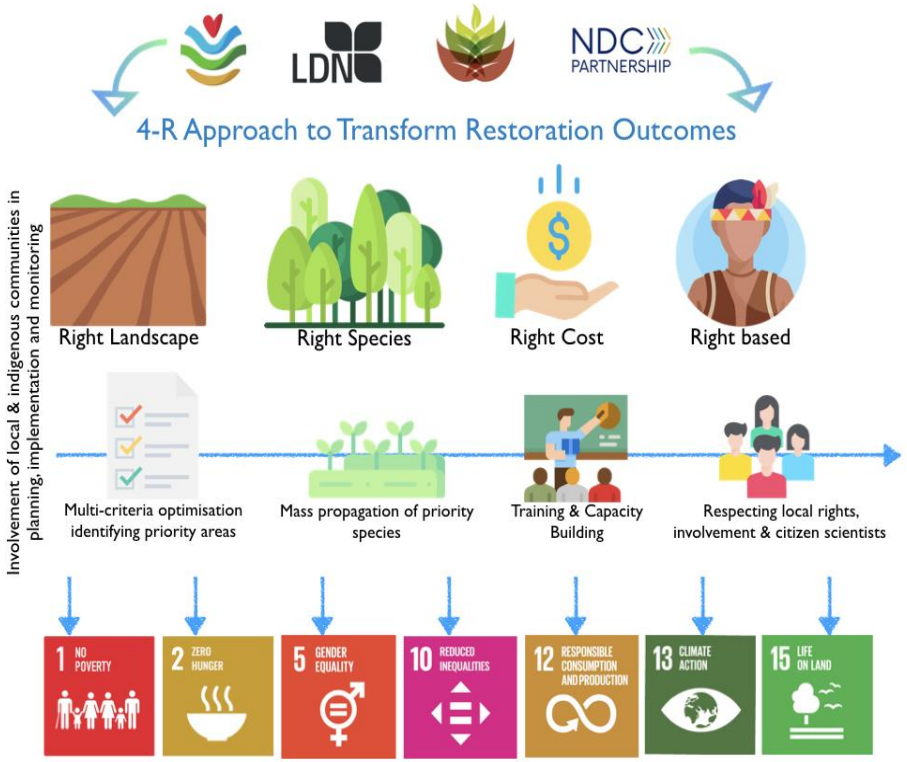

Disaster Resilience and Green Growth
Series Editors: Anil Kumar Gupta
Sivapuram Venkata Rama Krishna Prabhakar · Akhilesh Surjan
Shalini Dhyani
Anil Kumar Gupta
Madhav Karki Editors
Nature-based Solutions for Resilient Ecosystems and Societies
Springer


Shalini Dhyani
Mrittika Basu
Harini Santhanam
Rajarshi Dasgupta Editors
Blue-Green Infrastructure across Asian Countries
Improving Urban Resilience and Sustainability
Springer


Shalini Dhyani
Esther Katz Editors
Wild Edibles and Sustainable Development Goals
Springer

Promoting Climate-Sensitive approaches that support incentives and income diversification





RE-NEW (OPINION) ARTICLE

Integrated climate sensitive restoration framework for transformative changes to sustainable land restoration

Shalini Dhyani, Debbie Bartlett, Rakesh Kadaverugu, Rajarshi Dasgupta, Paras Pujari, Parikshit Verma

First published: 25 June 2020 | https://doi.org/10.1111/rec.13230 | Citations: 27

Chapter

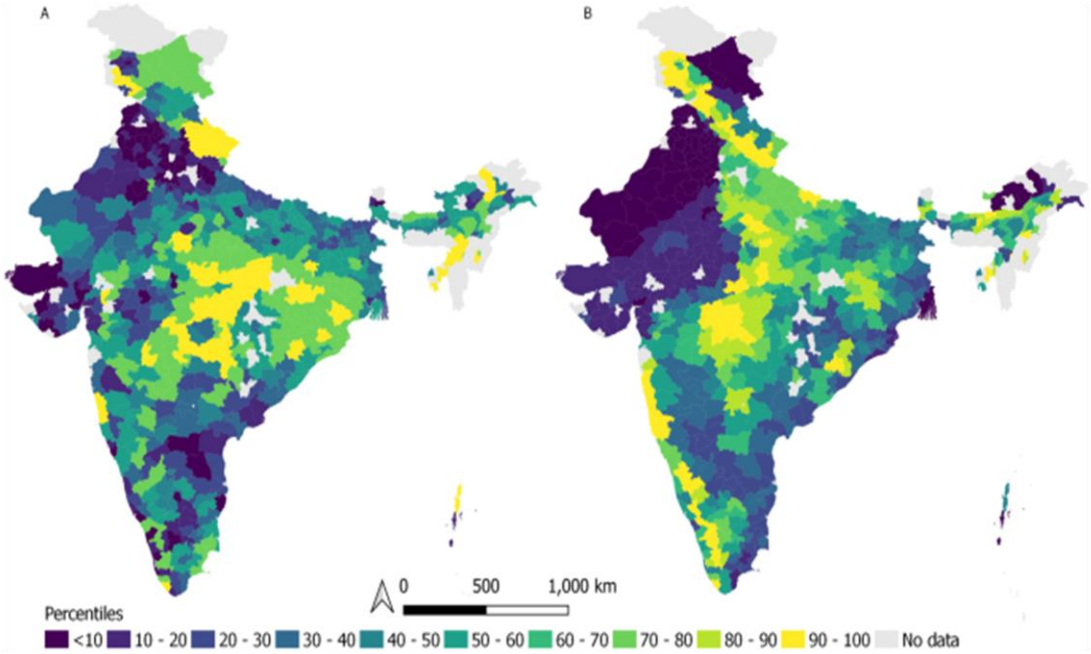
Endorsing Scientific Hybridization of Traditional Ecological Knowledge (TEK) for Enhancing Climate Change Adaptation (CCA) Across Diverse Sectors

By Suvha Lama, Shalini Dhyani, Atya Kapley, Rakesh Kumar

twas unesco The World Academy of Sciences

CIFOR

Enabling people-centric opportunities



Comment | Open access | Published: 01 March 2023

Combining socioeconomic and biophysical data to identify people-centric restoration opportunities

Pooja Choksi, Arun Agrawal, Ivan Bialy, Rohini Chaturvedi, Kyle Frankel Davis, Shalini Dhyani, Forrest Fleischman, Jonas Lechner, Harini Nagendra, Veena Srininvasan & Ruth DeFries

npj Biodiversity **2**, Article number: 7 (2023) | Cite this article

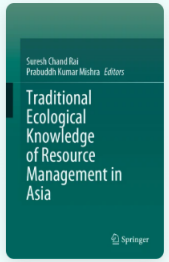
- 116 of the poorest districts among 579 districts with high biophysical restoration potential & predominant land tenure being private
- Local consultations & need assessments
- Opportunity to focus on agri-pastoral restoration over carbon and forest-based restoration projects
- People-centric approaches to help policymakers translate global NbS prioritization for application

Mainstreaming Indigenous and Traditional Ecological Knowledge (TEK) Systems in Global Climate Policy for Resilient Ecosystems and Societies

Chapter | First Online: 21 September 2024
pp 485–507 | Cite this chapter

Is Validation of Traditional Ecological Knowledge for Natural Resources Management and Climate Change Adaptations Against Western Science a Wise Idea: Exploring Relevance and Challenges

Chapter | First Online: 02 January 2023
pp 289–302 | Cite this chapter



Traditional Ecological Knowledge of Resource Management in Asia

Co-designing, Co-implementing, Co-managing, Co-governing NbS can bring transformative changes..

Strategies for Reducing Deforestation and Disaster Risk: Lessons from Garhwal Himalaya, India

Shalini Dhyani ✉ & Deepak Dhyani

Chapter | First Online: 20 August 2016

1802 Accesses | **9** Citations

Part of the Advances in Natural and Technological Hazards Research book series (NTHR,volume 42)

Science & Technology Development/Policy Issues | Published: 10 August 2013

Utility of Fodder Banks for Reducing Women Drudgery and Anthropogenic Pressure from Forests of Western Himalaya

Shalini Dhyani ✉, R. K. Maikhuri & D. Dhyani

National Academy Science Letters **36**, 453–460 (2013) | Cite this article

COPAL

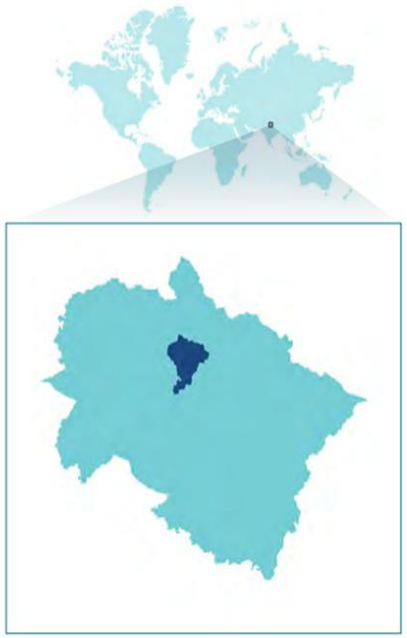
विज्ञान एवं प्रौद्योगिकी मंत्रालय
MINISTRY OF SCIENCE AND TECHNOLOGY
सत्यमेव जयते

CSIR
भारत का नवाचार इंजन
The Innovation Engine of India

नीरी
NEERI

1 NO POVERTY
2 ZERO HUNGER
5 GENDER EQUALITY
10 REDUCED INEQUALITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
15 LIFE ON LAND

Fodder bank model to address deforestation, soil erosion, slope stability & women drudgery



Societal challenges

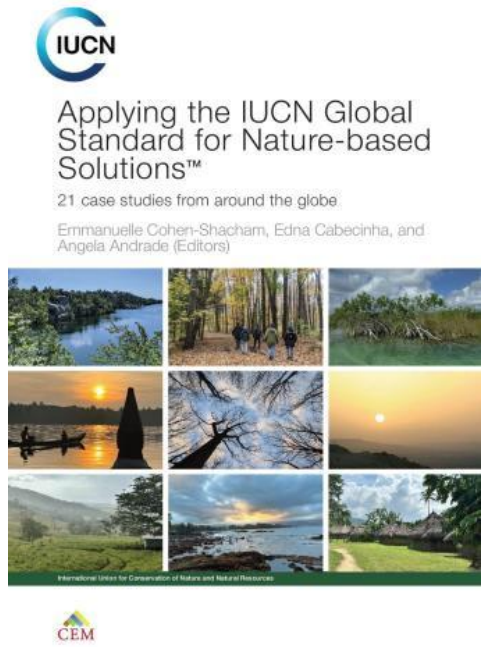
Types of NbS

Eco-DRR | EE | ER

Type of biome

T2 – Temperate-boreal forests

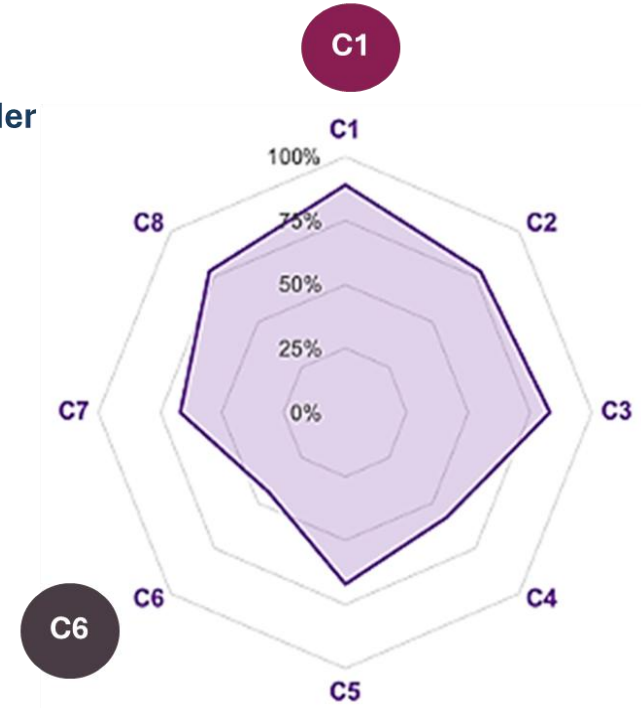
Stakeholders

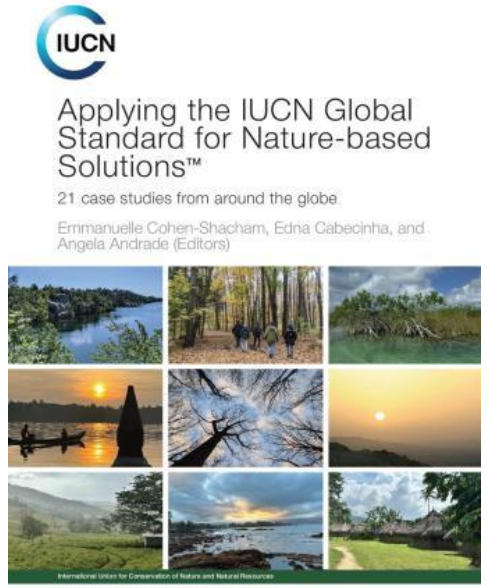


Strongest criterion: C1 – Societal challenges

- FB effectively addressed societal challenges **(women drudgery linked with fodder collection during lean periods, their health and education issues)**



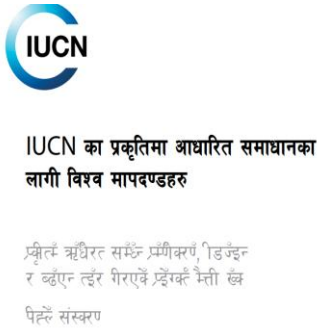


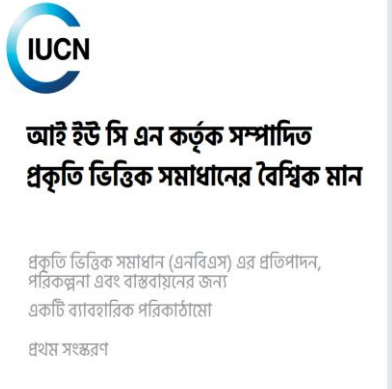


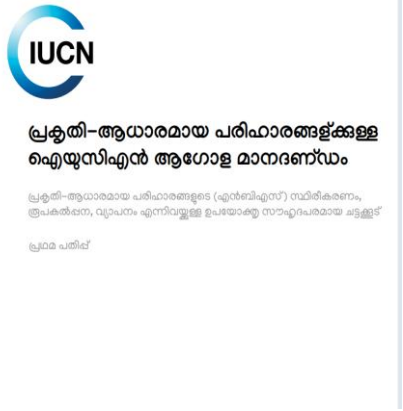
Weakest criterion: C6 – Balance trade-offs

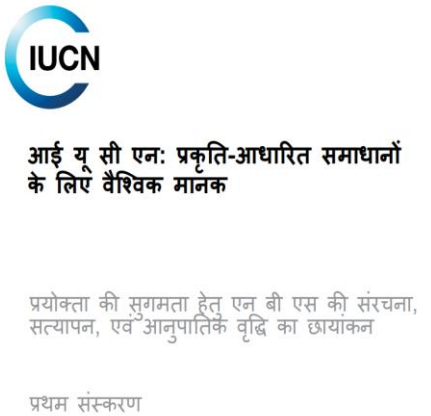
- **Shortage of funds**, **insufficient initial resources, and technical expertise in economic valuation,** followed by **historical land right issues**, replicating and scaling up the NbS approach took longer than expected.

IUCN NbS Global Standards Translations Promoting and capacity building in local language









4 QUALITY EDUCATION

10 REDUCED INEQUALITIES

Short videos also there for wider outreach and awareness

Key Enablers for Centering Justice in Climate Risk Management for Transformative Change…

- Finances
- Multi-sectoral & People centric
- Monitoring big data generated
- Relevance and Acceptance
- Incentives
- Inclusion
- Convergence
- Innovations & Effectiveness
- Sustainability

Key Takeaways:

- To enhance the effectiveness of the promises, embedding diverse knowledge systems including indigenous knowledge systems and capabilities and mainstreaming the possibilities to integrate with scientific solutions for acceptance and localization

- Supporting efforts and formulating policies that incentivize environmental restoration, people-centric, climate sensitive strategies

- Convergence between different government departments as well as schemes to improve the benefits on ground

- Mainstreaming of systems thinking as a social transformation approach for achieving coupled Climate, KMGBF and Land Degradation Neutrality targets by 2030 and 2070.

- Mechanisms for public contributions and permanent access to scientific discoveries and innovations to strengthen public trust in scientific and knowledge organizations...

Thank you for your patience!!

shalini.dhyani@csir.res,in; shalinidhyanineeri@gmail.com