Proceedings of the International Workshop on
Interdisciplinary Approach to Climate Change Education
February 27–28, 2025
Kochi, Kerala, India

Organized by
INDO-DUTCH RESEARCH CENTER ON CLIMATE CHANGE LAW, RESEARCH AND EDUCATION
In collaboration with
Government Law College, Ernakulam
Van Vollenhoven Institute for Law, Governance & Society,
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Climate Change and Legal Education -Vol. 1
Governance, Law & Global Frameworks

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Edited By
Dr Dayana MK and Dr. Rhea Roy Mammen

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Climate Change and Legal Education

Vol. 1: Governance, Law & Global Frameworks

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Climate Change and Legal Education
Vol. 1:
Governance, Law & Global Frameworks

Contents

PREFACE

The bare tree stands sentinel against the amber sky, its roots deep in parched earth, while across a winding path, its verdant counterpart flourishes in emerald abundance. This stark duality—captured in the image that graces our cover—embodies the profound choices that define our climate moment. We stand at the threshold between desolation and regeneration, between legal systems that perpetuate environmental degradation and those that herald ecological justice.

Law, in its highest expression, has always been humanity's attempt to create order from chaos, justice from inequity. Today, as rising seas challenge our coastal cities and unprecedented heatwaves rewrite meteorological records, the legal profession faces its most consequential test: Can jurisprudence evolve swiftly enough to match the pace of planetary change?

This first volume emerges from a recognition that climate change is not merely a scientific phenomenon requiring technical solutions, but a crisis of governance that demands legal innovation, institutional transformation, and a fundamental reimagining of how law relates to the natural world. The barren landscape need not be our destiny; the flourishing tree reminds us that regeneration remains possible when we choose the right path forward.

We extend our profound gratitude to the Indo-Dutch Research Centre on Climate Justice Law and Education, established through the visionary partnership between Government Law College, Ernakulam, and Leiden University, Netherlands. This collaboration represents exactly the kind of international cooperation essential for addressing

planetary challenges that transcend borders. Through their certificate courses and workshops on climate justice, they have created a crucible where legal minds from diverse traditions converge to forge new frameworks for environmental governance.

The scholars, practitioners, and students who have contributed to this volume understand that climate justice is not a distant aspiration but an urgent imperative. Each chapter represents a bridge, spanning the chasm between existing legal structures and the adaptive governance systems our changing world demands. Like the path winding between the two trees in our cover image, this book offers direction for those ready to journey from the familiar terrain of traditional environmental law toward the flourishing possibilities of climate justice.

The future will judge whether this generation of legal scholars and practitioners possessed the wisdom to choose regeneration over desolation, justice over convenience, hope over despair. This volume is our collective answer—a resounding commitment to the flourishing tree, to the green path, to the possibility that law can yet serve as guardian rather than destroyer of our planetary home.

This volume was made possible through the groundbreaking work of the Indo-Dutch Research Centre on Climate Justice Law and Education, a collaborative initiative between Government Law College, Ernakulam, and Leiden University, Netherlands. Their certificate courses and workshops on climate justice have created a new paradigm for international legal education, demonstrating that the most pressing challenges of our time require the most innovative approaches to learning and scholarship.

We thank all contributors, participants, and supporters who have made this educational journey possible, and who continue to walk the path between worlds in service of climate justice.

As we write these words in 2025, the window for meaningful climate action remains open, but it narrows with each passing season. May this work contribute to the urgent task of widening that window through the transformative power of law.

Dr. Dayana M.K.,
Associate Professor, and Coordinator of Indo-Dutch Research Centre,
Government Law College, Ernakulam

JUSTICE SYAM KUMAR V.M.
JUDGE
HIGH COURT OF KERALA
ERNAKULAM

Madhavam, 353/11
Snehatheeram Colony
Behind SNDP Hall
South Chittoor, Ernakulam
Kerala, PIN 682 027

05.08.2025

INTRODUCTION

Our planet is reeling under the pressures of climate change. None of us are free from its devastating impacts. Efforts are on from across all sectors of society to tackle its challenges. The legal system, being a foundational pillar of governance, is tasked with playing a pivotal role in mitigating the impacts of climate change.

The importance that law affords to this topic is revealed from the observation of the Hon'ble Supreme Court of India in **M.K. Ranjithsinh and others v. Union of India** (2024) wherein it was declared that the "right to be free from the adverse effects of climate change" is integral to the fundamental rights enshrined under Articles 21 and 14 of the Indian Constitution, which guarantees right to equality and life.

The felt necessities of the times in which we live have compelled us to evolve localised and varied legal strategies to combat the effects of climate change. Over a period of time, the impacts of climate change have become more intense and diverse, making the role that the legal system plays in shaping, regulating, and responding to environmental change both challenging and complex.

Legal interventions to tackle climate change, though, have been remarkable, yet at times they tend to be localised and singular. It is beyond doubt that we can make further strides only by consolidating

these diverse experiences and adopting a comprehensive, global perspective on the legal trajectories undertaken. Such a holistic approach could reveal to us a broader legal landscape and assist us in charting a more coherent and effective path forward.

The book at hand is an effort in the said direction.

By engaging in region-specific and localised studies, the articles in this compilation examine the rapidly evolving legal dimensions of climate change, their intersections with environmental governance, human rights, trade, health, and migration. They analyse how legal frameworks at local, national, and international levels are responding to emerging climate-related challenges and suggest the future course. A brief overview of the articles in these volumes would reveal the varied topics that they cover, as well as their academic depth and critical relevance to climate change law.

In "Challenges to the Governance of Maritime Pollution in the Arctic and the Need for a Collaborative Approach" the environmental risks posed by increased maritime activity in the Arctic are addressed. It assesses existing frameworks such as UNCLOS and the Polar Code and argues for broader cooperation between Arctic and non-Arctic states. In the present digital age, the scope of online platforms in amplifying advocacy efforts and facilitating transnational engagement is examined in the article titled "Leveraging Social Media for Climate Advocacy", which outlines the role of digital networks in mobilizing climate action. In "The Private Sector and Climate Change", the author investigates corporate social responsibility within climate governance, examining the influence and limitations of voluntary compliance in private sector responses. Drawing on a coastal adaptation case study, "The Relevance of Dutch Coastal Management Strategies for Kochi's Adaptation to Sea Level Rise" considers how international practices may inform local strategies in Kerala. "The Role of International Legal Frameworks in

Addressing Climate Change" evaluates global cooperation mechanisms and highlights the institutional limitations alongside opportunities for improving legal responses. Tensions between climate policy and international economic regimes, particularly in the context of trade and investment disputes, are analysed and explored by the author under the title "Green Deals or Legal Battles?"

The perennial issue of how climate-induced health threats intersect with legal protections in a globalised context, is reviewed with much focus on the evolving role of human rights frameworks in the article "Climate Change, Health and Human Rights". The much needed socio-legal reading of how institutional decisions and public policy contribute to mitigation efforts are dealth with elaborately in the essay "The Role of Policy and Governance in Climate Change Mitigation". An often neglected though important area of indigenous knowledge and legal protections is examined in "G.I. Law, Climate Change, and Indigenous Rights" through a broader conversation on environmental governance in Northeast India. "Changing Food Safety Standards the Era of Climate Change under the SPS Agreement" investigates how agricultural and trade-related regulations adapt to environmental shifts under WTO provisions. In "Legal Approaches to Protecting Climate Migrants," the author outlines emerging legal challenges related to climate-induced displacement and identifies gaps in existing protection mechanisms.

Coming home, the article titled "Integration of Global Models into Local Scenario: Shielding Kerala from Climate Change Issues" focuses on adapting international climate strategies to local environmental and governance conditions. "Socio-Economic Impacts of Climate Change on the Indigenous Communities of Assam" documents the consequences of climate shifts on vulnerable populations, highlighting regional disparities and resilience challenges. "Governing Climate

induced Migration in South Asia" critically examines institutional responses to environmental migration in India and Bangladesh, emphasising governance gaps. "Climate Displacement in the Global South as a Defining Ecological Tipping Point" presents a legal argument calling for more urgent responses to displacement driven by climate factors. "Climate Change and Right to Health in India" raises the question of whether the Indian legal system requires specific statutory provisions to address the health effects of climate change. "The Evolution of Climate Change Legislation in lndia" traces the progression of India's environmental laws, mapping the shift from general protection frameworks to climate-specific regulation. "Brahmapuram Incident A Threat to Climate" recounts a local environmental incident that occurred closer to home and evaluates its implications for policy implementation and climate accountability. Climate Modeling in Land Management discusses the role of data-driven modeling in shaping ecologically sound land use policies and management systems and the article titled "Global Strategies, Kerala's Challenges" assesses how international climate and disaster resilience models can be recalibrated to address local risks and vulnerabilities. The closing contribution, "Climate Emergency and Human Rights," reflects on the legal relevance of human rights frameworks in responding to climate crises, with particular reference to the Indian context.

This collection thus offers a diverse set of perspectives grounded in legal analysis, regional inquiry, and policy reflection. The contributions made transcend local, national, and global scales, and together they illuminate how legal institutions, governance systems, and policy mechanisms are adapting to the complexities introduced by climate change. The strength of this compilation lies in its ability to be both region-specific and globally oriented, offering localised insights while engaging with multinational legal and policy frameworks.

The final takeaway of this book, I reckon, is the need for a collaborative, adaptive, and rights-based legal approach to effectively address the complex and multidimensional impacts of climate change.

I congratulate the authors and the Government Law College, Ernakulam and Leiden University for their efforts. This compilation is a phenomenal contribution to law and climate change studies in India. I am sure that it will be well received by the learned and the layman.

Justice Syam Kumar V.M.

MESSAGE

Venu Rajamony
Former Ambassador of India to the Netherlands;
Chairman, Future Kerala Mission, Jain University, Kochi &
Professor of Diplomatic Practice, O.P. Jindal Global University, Sonepat

It is with great satisfaction and hope that I extend my heartfelt appreciation to the Indo-Dutch Centre on Climate Change Law Research and Education for the inspiring strides it has taken since its inception. As the person who had the honour of inaugurating this vital initiative, I have followed its evolution with both pride and keen interest.

Today, the climate crisis stands as the foremost existential and developmental challenge of our century. Its consequences are already being deeply felt across continents — from the retreating glaciers of the Alps to India's drought-stricken farmlands, from unprecedented floods in Europe to devastating heatwaves across South Asia. It is no longer an issue of future generations alone; it is a humanitarian, socio-economic, and legal emergency of today. Our response must be immediate, inclusive, and internationally coordinated.

India, with its vast coastline, agrarian economy, and vulnerable communities, is at high risk of bearing the brunt of rising sea levels, water scarcity, and extreme weather events. Europe too is facing increasingly severe climate disruptions, with implications for infrastructure, public health, and energy security. For the world at large, the failure to act decisively threatens to accelerate instability, deepen inequality, and erode the very ecological foundations on which our societies rest.

In this context, legal frameworks and scholarly cooperation across borders play a pivotal role. Climate change does not recognise the jurisdictional borders that define our policies; hence, our laws and research cannot remain confined to them either. Robust climate governance requires international solidarity, shared learning, and collaborative innovation. It is here that the Indo-Dutch Centre emerges as a beacon — a unique platform fostering dialogue between legal traditions, academic communities, and the lived realities of different regions.

The Netherlands has long been a pioneer in integrating law with environmental ethics. Its leadership in climate litigation — particularly the landmark *Urgenda* ruling holding the state accountable to its climate obligations — has inspired movements far beyond Europe. By channeling Dutch experience into Indian legal education and research, the Centre exemplifies the power of purposeful partnership.

The Centre's initiatives — from the interdisciplinary *Certificate Course* and transformative *International Workshop* to the visionary *Faculty Development Programme* — are not just academic milestones; they are catalysts for systemic change. By linking legal education with climate realities, the Centre is grooming a new generation of legal minds to think globally, act locally, and legislate ethically.

Moreover, the Centre's inclusive, student-focused approach ensures that climate law is not merely taught, but experienced and reimagined through the lenses of justice, empathy, and critical inquiry. Its focus on issues such as climate-induced displacement, indigenous rights, local governance, and corporate responsibility reflects an admirable recognition of the multifaceted nature of climate justice.

In doing so, the Centre is building what international jurist and Nobel laureate Amartya Sen once called the "infrastructure of justice" — not

only by sharpening legal tools, but by fortifying the moral convictions that give them purpose.

As António Guterres, Secretary-General of the United Nations rightly warned, “Climate change is moving faster than we are. We must catch up. We must rise to the challenge — together.”

The worsening impacts of climate change compel us not just to act — but to act together. International collaboration in climate law and research is not a matter of choice; it is an urgent necessity. The Indo-Dutch Centre's seamless blending of academic integrity, cross-border dialogue, and social relevance makes it a path-setter for similar global initiatives.

I congratulate the faculty coordinators, institutional partners, scholars, student leaders, and supporters of the Centre for their vision and tireless efforts. I remain confident that this platform will continue to grow in influence and impact — contributing to a future where law is not just a shield against climate injustice, but a transformative force for ecological and human dignity.

May the work of the Centre continue to inspire, inform, and transform — within classrooms, across borders, and for generations to come.

Venu Rajamony

July 29, 2025

MESSAGE FROM THE DIGNITARIES

We are delighted to present the proceedings of the International Workshop on Interdisciplinary Approach to Climate Change Education, jointly organized by the Indo-Dutch Research Center on Climate Change Law, Research and Education, which is co-jointly honoured by the Higher Education Department, Government of Kerala under the aegis of Government Law College, Ernakulam, and the Van Vollenhoven Institute of The Netherlands.

This workshop stands as a remarkable confluence of thought leaders, scholars, practitioners, and students, dedicated to confronting one of the most pressing global challenges of our time — climate change. Through a unique interdisciplinary lens, the event has facilitated vital conversations on legal education, governance mechanisms, global frameworks, and local adaptation strategies essential to climate resilience.

We are particularly proud of the platform this initiative has provided for emerging researchers and young professionals to present their insights, case studies, and innovative solutions. The depth and diversity of the perspectives shared during the sessions underscore the urgency of integrated climate education within the broader legal and policy framework.

Our heartfelt gratitude extends to all the contributors, paper presenters, moderators, and participants who enriched this academic dialogue. We also acknowledge the tireless efforts of the faculty and student coordinators whose commitment brought this event to life.

We hope these volumes serve as a lasting academic resource and a catalyst for future collaborations on climate education and environmental law.

Let us continue to work together—across disciplines and across borders—to foster a sustainable and equitable future for all.

With warm regards,

Dr. Bindu M. Nambiar
Principal, Government Law College, Ernakulam

Dr. Adriaan Bedner
Professor, Van Vollenhoven Institute
Leiden University, The Netherlands

Dr. Dayana M. K.
Faculty Coordinator
Indo-Dutch Research Center

Dr. Rhea Roy Mammen
Project Coordinator, Indo-Dutch Research Center
Lecturer, Leiden University

THEME OF THE CONFERENCE

Overview of the Event

The International Workshop on Interdisciplinary Approach to Climate Change Education, held on February 27–28, 2025, at Government Law College, Ernakulam, brought together academics, legal experts, environmentalists, policy-makers, and students to engage in a rich exchange of ideas. Hosted collaboratively by the Indo-Dutch Research Center on Climate Change Law, Research and Education, the Van Vollenhoven Institute of Leiden University, and Government Law College, this workshop aimed to create a platform for exploring the intersection of law, governance, education, and climate change.

Goals and Key Themes

The primary goal of the workshop was to foster a multidisciplinary approach to climate change education. Key themes included:

- Governance frameworks and legal responses to climate change
- Climate justice and human rights
- International cooperation and global environmental law
- Interdisciplinary teaching methods in legal education
- Local adaptation strategies and community engagement
- Climate-induced displacement, sustainability, and policy development

Significance of the Topic

Climate change presents complex legal, social, and environmental challenges that transcend traditional disciplinary boundaries. As the world faces intensifying climate-related crises, the need for informed legal responses and climate-literate professionals is more urgent than

ever. This conference emphasized the critical role of interdisciplinary education in empowering future leaders and legal professionals to develop resilient, inclusive, and sustainable solutions. The dialogue and research showcased in this workshop contribute to evolving jurisprudence and academic discourse on climate change law and policy.

I

CHALLENGES TO THE GOVERNANCE OF MARITIME POLLUTION IN ARCTIC AND THE NEED FOR A COLLABORATIVE APPROACH

P R Bharath Chandran Nair[*], Mitha Ramesh[**]

ABSTRACT

Climate Change and the melting of the sea ice has resulted in increased maritime activity in the Arctic. The Arctic shipping occurs by three routes mainly - Northwest Passage, Northeast Passage, and transpolar sea routes. While the maritime sector only amounts to mere 12 percent of global marine pollution, it is a major contributor to marine pollution in the arctic region. The key threats include use of Heavy Fuel Oils (HFO), black carbon emission, discharge of wastewater, underwater noise pollution, habitat loss etc. United Nations Convention on the Law of the Sea (UNCLOS) and the Polar Code along with domestic regulations of arctic coastal states like Canada and Russia are the main legal frameworks that regulate the Arctic maritime activities. The rising tensions between the Arctic and Non-Arctic over the navigational rights has revealed the flaws in these legal frameworks. It advocates for the strengthening of existing frameworks through international cooperation, stressing that Arctic nations should prioritize environmental preservation over claims of absolute control. The fragile nature of the Arctic calls for more stringent and special provisions

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in the current international arguments. The effective implementation of the environmental protection will require collaborative approach among the Arctic states, observer states and various stakeholders. This paper aims to explore critical legal deficiencies in both the international and regional regulations and assess the importance of global assistance and collaboration in research and climate action.

Keywords: *Polar Code, Arctic States, Arctic Council, Climate change, Collaboration*

10. INTRODUCTION

Climate change and maritime pollution are not mutually exclusive. They amplify each other's impact rather than existing separately. The ocean plays a crucial role in this relationship, absorbing 91 percent of the heat emitted by the greenhouse gases and 30 percent of the carbon emissions. This leads to what the scientific community calls the deadly trio – rise in temperature, acidification and deoxygenation. These phenomena can create ripple effects that can affect both the marine ecosystem and the lives of the indigenous people dependent on them. This creates a feedback loop where the emissions from shipping create climate change which in turn further degrades the arctic environment. Rather than viewing these two issues as separate, policy-makers must consider them in tandem when making regulations. Arctic states have enjoyed sovereignty over the arctic region for the longest time; states like Russia and Canada have formulated rules restricting navigation through the region and for the prevention of environmental degradations. But the issue at hand, due to its pervasive nature, needs much more global assistance than what is the case in the present scenario. To

ensure quick action against the rapidly degrading environment in the Arctic, there is a need for global assistance and proper cooperation between the Arctic states and non-Arctic states in both climate action and research and education.

11. ARCTIC ECOSYSTEM AND ENVIRONMENTAL CHALLENGES

The Arctic region is surrounded by coastal areas that are periodically covered with sea ice. Moving eastwards of Greenland, the Arctic basin is adjoined by the Greenland Sea, Norwegian Sea, Barents Sea, White Sea, Kara Sea, Laptev Sea, East Siberian Sea, and Chukchi Sea, all of which lie in proximity to the Eurasian landmass. The northwest passage has waters located within the Bering Sea, Beaufort Sea and the Canadian Archipelago and the Hudson Bay. Hudson Strait, Lincoln Sea, Baffin Bay and Labrador Sea adjoin the North American continent.[1]The influx of fresh water from the melting of ice and river systems has resulted in considerable stratification in the arctic environment. This phenomenon has resulted in the formation of an upper layer that contains significantly lower salinity when compared to the other oceans. The distribution of various elements, including nutrients, organic matter, plankton, larvae of fish and other invertebrates, among the different straits, are done by the ocean currents from the Atlantic and Pacific oceans. The eastern section of the Fram strait contributes to the Arctic warm saline water from the Atlantic, whereas the Bering Strait contributes from the Pacific water with lower salinity. The

[1] Arctic Council, *Arctic Marine Shipping Assessment 2009 Report* (2009) <https://www.pmel.noaa.gov/arctic-zone/detect/documents/AMSA_2009_Report_2nd_print.pdf> accessed 25 February 2025.

western strait serves as the major conduit for water exiting from the Arctic Ocean.[2]

The presence of sea ice, seasonality of the environment and the influence of the continental shelf are elements that shape the biodiversity found within the Arctic ecosystem.[3] The geographical characteristics of the Arctic have made it a semi-isolated habitat, facilitating the emergence of a unique ecosystem. The arctic, being considerably quieter than the other oceans, has organisms that have evolved to thrive in such tranquil environments. The ambient noise in the arctic consistently remains relatively low with a flare-up occurring only in the event of ice fracture and break-ups. Sound waves can propagate unusual distances, hundreds of kilometres, as a result of the cold, denser saline water and the sea ice acting as a conduit. Arctic marine species have developed the ability to utilize sound for various essential activities, including navigation, reproductive behaviour, and hunting, particularly during the prolonged dark and frigid winter months.[4]

The stressors of the arctic environment can be put under two heads-global stressors and maritime stressors. The global stressors are the culmination of the after-effects of global warming and climate change, whereas the

[2] Joan Eamer and others, 'Life Linked to Ice: A guide to sea ice-associated biodiversity in this time of rapid change' (2013) <https://www.researchgate.net/publication/263539952_Life_Linked_to_Ice_A_guide_to_sea-ice-associated_biodiversity_in_this_time_of_rapid_change> accessed 25 February 2025.

[3] Conservation of Arctic Flora and Fauna, 'Arctic Biodiversity Assessment: Status and Trends in Arctic Biodiversity' (UNEP, 2013) <https://wedocs.unep.org/20.500.11822/8668> accessed 25 February 2025.

[4] Warwick F Vincent and others, 'Shipping in Arctic Marine Ecosystems under Stress: Recognizing and Mitigating the Threats' (Brill | Nijhoff 2023) 37 <https://brill.com/edcollchap-oa/book/9789004508576/BP000015.xml?body=contentsummary-60827> accessed 24 February 2025.

maritime stressors are a result of poorly regulated environmental protection regulations.

Global Stressor –

Snow and ice are essential components of the Arctic ecosystem. The increase in global temperature has brought about serious repercussions, not limited to but including, habitat destruction, alteration in current patterns and the introduction of invasive species. From 1979 to 2020, there has been a 48 percent reduction in the sea ice area and a 77 percent reduction in the sea ice volume approximately.[5] This persistent habitat degradation exerts tremendous stress on the rich wildlife that inhabits the Arctic. The changing conditions in the Arctic significantly influence both winter and summer cycles, impacting light availability and the melting of winter ice. This disruption hinders the growth of vital flora, sea ice algae, that are depended upon by a multitude of faunae as a food source. Shifts in salinity can easily replace the predominantly found diatoms with smaller phytoplankton that are capable of thriving in nutrient-scarce waters.[6] Such changes can dramatically influence the food web as the diatoms are at the base of the food web being fed upon by the Arctic copepods, a key food source for ringed seals, which are then hunted by polar bears. Even a minor alteration like this can have consequences of a disproportionate level that can bring down the entire ecosystem. Additionally, thinner ice can result in stronger

[5] David Docquier and Torben Koenigk, 'A Review of Interactions Between Ocean Heat Transport and Arctic Sea Ice' (2021) 16 Environmental Research Letters <https://doi.org/10.1088/1748-9326/ac30be> accessed 25 February 2025.

[6] Caroline Bouchard and Louis Fortier, 'The Importance of *Calanus glacialis* for The Feeding Success of Young Polar Cod: A Circumpolar Synthesis' (2020) 43 Polar Biology 1095 <https://doi.org/10.1007/s00300-020-02643-0> accessed 26 February 2025.

ocean currents which can pave waves to further run away from the Atlantic Ocean further complicating the already stressed ecosystem.

Maritime Stressor –

The effect of shipping on marine life is a whole different array of problems. They can be – chemical stressors, physical stressor and biological stressor.

Chemical pollution from vessel collisions and discharges, stemming from antifouling, greywater, ballast water etc, poses a significant threat to marine ecosystems worldwide. The geographic location of the Arctic with its remoteness and lack of human infrastructure, makes chemical pollution all the more dangerous as the clean-up process is severely hindered. The cold temperatures in this region slow down the natural breakdown of hydrocarbons by microbes, making cleanup efforts even more difficult. Atmospheric emissions resulting from the burning of fuel are another concern. It deposits black carbon, Sulphur and nitrogen oxides and other particulates that can hasten the melting of the snow.[7]

The Integrity of the Ice is one of the physical aspects that is of paramount importance for the Arctic ecosystem. Icebreakers, specially made ships used for navigation, break apart the sea ice when navigating through the frozen arctic. The sea ice serves as the habitat and migratory pathway for a multitude of faunae including but not limited to keystone species like the polar bear. The destruction of the sea ice causes severe habitat loss while also interfering with the migratory pathways. This, when compared with the already rising temperature, hastens the process of ecological degradation.

[7] Wanmin Gong and others, 'Assessing The Impact of Shipping Emissions on Air Pollution in The Canadian Arctic and Northern Regions: Current and Future Modelled Scenarios' (2018) 18 Atmospheric Chemistry and Physics <https://doi.org/10.5194/acp-18-16653-2018> accessed 26 February 2025.

The disruption caused by ice-breaking activities leads to habitat loss and interferes with migratory pathways for many Arctic organisms. Additionally, the Arctic Ocean is generally quieter than other oceans, with noise levels rising primarily during ice-breaking events. Noise pollution from vessel activity can disrupt the natural behaviour of various marine animals, particularly species like narwhals that rely on sound for navigation.

A major worry is the introduction of non-native marine species, invasive species, through the discharge of ballast water. As ships navigate from different areas, they can transport organisms in their ballast water and release them into Arctic waters. The increasingly early start of the shipping season has raised a new concern on the west side of the Archipelago: the potential disturbance of sea-ice dependent species.[8] These invasive species, lacking natural predators, can upset local ecosystems and significantly endanger biodiversity. Invasive species, not being native, can fester in the local ecosystem, causing the native ecology to slowly crumble.

The effects of these stressors, global and maritime, show up in a cumulative form breaking down the environment drastically ever so slowly. The need for proper integration of the environmental regulations regarding maritime activities is thus important as the after-effects of the failure to do so will have consequences far beyond the Arctic.

12. POLAR CODE AND ITS LIMITATIONS

The International Maritime organisation, IMO, with the initiation of the International Code for Ships operating in Polar Waters or the Polar Code

[8] Julia Olsen, Natalie Ann Carter and Jackie Dawson, 'Community Perspectives on The Environmental Impacts of Arctic Shipping: Case Studies From Russia, Norway And Canada' (2019) 5 Cogent Social Sciences <https://doi.org/10.1080/23311886.2019.1609189> accessed 26 February 2025.

gained certain authorities in managing and regulating maritime activities. Polar Code is not a stand-alone convention under IMO but in the form of three amendments. The polar code is an amalgamation of three amended conventions, namely The International convention for the prevention of pollution from ships (MARPOL), The International convention for safety of life at sea (SOLAS) and the international convention on standards of training, certification and watchkeeping for seafarers (STCW). Both Russia and Canada are parties to these three conventions.[9] The amendment to the Polar Code has made the provisions of the same mandatory. The polar code, though an effective approach at maritime environmental regulation, is flawed on many fronts.

The flaws of the polar code can be summed up in three issues – the lack of unilateral implementation, the non-inclusion of shipping vessels and the ban on heavy fuel oils. In the process of adopting the Polar Code, Canada and Russia clearly articulated their respective positions on how it aligns with their national laws. Russia stands adamantly on the stand that the domestic legislation would take precedence over the polar code, taking a more economically driven approach. Canada, on the other hand, implemented stricter environmental legislation but struggles to enforce it as its scope is severely limited. Thus, while it can be said that both countries have implemented the provisions of the polar code, the said implementation leaves a lot to be desired in terms of actual regulatory capabilities. For example, Canada's Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR) impose stricter emission standards than those

[9] Kristin Bartenstein, 'Between the Polar Code and Article 234: The Balance in Canada's Arctic Shipping Safety and Pollution Prevention Regulations' (2019) 50 Ocean Development & International Law < https://doi.org/10.1080/00908320.2019.1617932> accessed 26 February 2025.

outlined in the Polar Code. Additionally, there are limitations on the navigable areas and times for certain types of vessels, and non-SOLAS ships are required to have pilots in designated regions.[10]

In 2019, The Protection of the Arctic Marine Environment (PAME), in its report titled "the increase in Arctic shipping 2013–2019" showcased notable transformation, with 25 percent increase in the vessel traffic in the arctic region, 41 percent of the vessels navigating the arctic waters being fishing vessels. The SOLAS regulation 3 excludes fishing vessels from its provisions, thus making fishing vessels an exemption to the polar code. Despite the Polar Code imposing stringent technical standards for ships operating in these icy waters, fishing vessels often struggle to comply with these requirements. To enhance safety for both navigation and environmental protection, it is essential for the Polar Code to establish specific safety criteria tailored for fishing vessels, especially given their increasing presence in the Arctic shipping routes.

The Arctic shipping is primarily reliant on fossil fuels, more specifically, the heavy fuel oil (HFO) which is a major contributing factor to the release of sulphur oxides, heavy metals, volatile organic compounds and black carbon particles, which catalyses the process of arctic thawing.[11] The cold climate of the arctic means that the heavy oil fuels are often not completely combusted, resulting in black carbon particles. The black carbon particles

[10] Cheng Zhang and Jia-qi Yang, 'Prevention and Control of Ship-Source Pollution in The Arctic Shipping Routes: Challenges and Countermeasures' (2023) 31 Environmental Science and Pollution Research < https://doi.org/10.1007/s11356-023-30817-w> accessed 1 March 2025.

[11] Qiang Zhang and others, 'Reducing Black Carbon Emissions from Arctic Shipping: Solutions and Policy Implications' (2019) 241 Journal of Cleaner Production < https://doi.org/10.1016/j.jclepro.2019.118261> accessed 25 February 2025.

when mixed with soot and cascade onto the snow, acts as a thermal barrier coating thus steadily increasing the temperature, while causing the heat to penetrate into deeper layers, ever so slowly warming up the arctic at a much faster pace compared to the Antarctic.[12] The International Maritime Organisation through the Polar Code have effectively banned the use of Heavy Fuel Oils (HFO) by the 1st July of 2024. The ban, however, comes with an exemption for vessels engaged in safety, protection, search and rescue operations, or meeting the fuel oil tank protection requirements that are exempt from the HFO ban. Additionally, ships registered in Arctic states will also be exempt. Ships meeting fuel oil tank protection requirements and Arctic States' ships have a 5-year transition. The exemption ends in 2029. This exemption and concurrent mandate to shift to Very Low Sulphur Fuel Oil (VLSFO) has negated whatever positive effects the ban of HFO had intended to provide. The use of HFO during the exemption period will result in the release of a significant amount of black carbon resulting in the further degradation of the arctic ecosystem.

The International Council on Clean Transportation (ICCT) in its report titled "Black Carbon emissions and fuel use in global shipping 2025" revealed that the effect of black carbon has increased five times at higher altitudes.[13] Despite this finding, black carbon is not included as a greenhouse gas under any of the international conventions. Although black carbon is accepted as a greenhouse gas in the Gothenburg Protocol, the same

[12] Yu Liang and others, 'Contribution of Warm and Moist Atmospheric Flow to A Record Minimum July Sea Ice Extent of The Arctic in 2020' (2022) 16 The Cryosphere < https://doi.org/10.5194/tc-16-1107-2022> accessed 26 February 2025.

[13] Bryan Comer, Naya Olmer, Xiaoli Mao, Biswajoy Roy, and Dan Rutherford, 'Black Carbon Emissions and Fuel Use in Global Shipping, 2015' (The International Council on Clean Transportation, 15 December 2017) < https://theicct.org/publication/black-carbon-emissions-and-fuel-use-in-global-shipping-2015/> accessed 26 February 2025.

does not make it mandatory to regulate the black carbon emissions. When MARPOL was amended to enforce the Polar Code, Annexure VI "Prevention of air pollution from ships" was not amended. Furthermore, the use of VLSFO has raised concerns about it being a high aromatic compound, thus leading to larger black carbon emissions.[14]

In 2018, an analysis of the influences the HFO ban brings to cruise shipping, took MS Rotterdam, IMO registration number is 9122552, as an object to initiate a case study. The study aimed to find the impact of HFO ban on fuel costs and ticket prices of cruise ships. The study found that the HFO ban would increase fuel costs for ships by 15–25% per voyage, but it should be noted that the impact on Arctic commercial cruise traffic would be minimal as the increase in costs would be spread over 1400 tickets. And if operators share the cost increase with passengers, the ticket increase will be much more minimal. Considering all these things, lower tax rates seem to mitigate negative influences. However, taxation reduction needs further communication with the surrounding Arctic nations.

13. REGIONAL REGULATIONS

13.1. Russia

Several Russian rules and regulations significantly affect the navigational rights of foreign ships, particularly in the Northern Sea Route (NSR). These measures demonstrate Russia's intent to control Arctic navigation while addressing maritime safety and environmental protection.

Decree On the Confirmation of the Statute of the Administration of the Northern Sea Route Attached to the Ministry of the Maritime Fleet (1971)

[14] Zhang (n. 13).

has laid out a broad framework for the operation of the Administration of the NSR (ANSR), enumerated its tasks and prerogatives, and mandated the ANSR to establish rules for navigation along the NSR.[15] The *Rules of Navigation in the Water Area of the Northern Sea Route (2013)* which is based on Article 5.1 of Merchant Shipping Code, requires obtaining permission to enter and navigate the NSR. This requirement applies in the whole 'water area' of the NSR, encompassing internal waters, territorial sea, and the Exclusive Economic Zone (EEZ). Items 10.6 and 23 stipulate the necessity of icebreaker assistance be provided in the permission granted by the ANSR. Mandatory icebreaker assistance and pilotage requirements only arise under specific circumstances, but the shipowner is required to send an application anyway. These regulations, along with historical practices such as cabotage laws and the requirement of prior authorization, enable Russia to maintain control over navigation in the NSR.

Russian regulations on warships and rules on prior notification and application have invited a lot of criticisms from other countries, mainly the US. Conflicts between international sea laws and Russian regional laws can also be seen especially in regions of straits and territorial waters of the Russian Arctic.

13.2. Canada

Canada has specific regulations regarding shipping in its Arctic waters, including the Northwest Passage. Canada asserts full control over the Northwest Passage, considering it internal waters. Under Article 234 of the United Nations Convention on the Law of the Sea (UNCLOS), Canada can

[15] Jan Jakub Solski, 'New Russian Legislative Approaches and Navigational Rights within the Northern Sea Route' (2020) 12 The Yearbook of Polar Law Online < https://doi.org/10.1163/22116427_012010015> accessed 2 March 2025.

adopt and enforce laws for the prevention and control of marine pollution from vessels in ice-covered areas within its exclusive economic zone. Canada has implemented the *Arctic Shipping Safety and Pollution Prevention Regulations (ASSPPR)* aligning its domestic laws with the IMO's Polar Code, while also including some "Canadian modifications". The "modifications" introduced by Canada include more stringent rules and restrictions.[16] The rules by Canada are said to be stricter than the Polar Code.

14. COLLABORATIVE APPROACH

Inclusive regionalism aims to increase regional governance with the global interest. It aims to quell the shortcomings of solely relying on regional arctic states in upholding the Arctic marine governance.[17] One of the major criticisms directed against the Arctic Council is regarding its organizational structure, inclusivity and effectively tackling the evolving circumstances of the Arctic region.

The Arctic Council has come under fire for the limited power it grants to observer states. The observer states often feel that their roles merely resemble that of non-governmental organizations, with the added worry that any of the member states could revoke their observer status. The non-Arctic states often put forth a collaborative approach, often questioning a purely regional strategy. They advocate for a global inclusive framework adhering to the provisions of UNCLOS ensuring that all countries have defined rights

[16] Pauline Pica, Julie Babina, Frédéric Lasserrea, Linyan Huanga & Kristin Bartenstein, 'The Polar Code and Canada's regulations on Arctic Navigation: Shipping Companies' Perceptions of The New Legal Environment' (2021) 11 The Polar Journal < https://doi.org/10.1080/2154896X.2021.1889838> accessed 1 march 2025.

[17] Carol Dyck, 'Arctic Governance in the Face of Climate Change: A Case for "Inclusive Regionalism' (2024) The Canadian Yearbook of International Law <https://doi.org/10.1017/cyl.2024.6> accessed 1 March 2025.

in the Arctic waters. A “high level forum” like the Arctic Council which focuses on cooperation and coordination often fails to impose tangible actions. This raises concern over its ability to address urgent environmental, economic, and social concerns.[18]

The Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 or the Helsinki convention,1992 illuminates the impact collaborative approach can have on environmental regulations. This treaty was implemented as a result of the growing concern over pollution in the Baltic Sea due to eutrophication, hazardous substances, overfishing and increasing maritime traffic. The success of the convention can be said to be because of the implementation and compliance of its provisions while also ensuring a collaborative approach among the member states. Strategies like the Baltic Sea Action Plan (BSAP) were used to tackle issues like eutrophication and decline in biodiversity, empowering stakeholders to adopt effective environmental practices grounded in the principles of precaution and polluter pay principles.[19] The collaborative efforts with the international community by means of co-ordinated effort have resulted in the successful implementation of the legal framework, leading to a drastic decline in the level of pollution in the Baltic Sea. The Helsinki Convention exemplifies the success model of International environmental governance.

In addition to the afore-mentioned convention, 10 parties—including the US, EU, Canada, China, Denmark, Iceland, Japan, Norway, Russia, Korea, and Denmark—have signed an agreement on October 3, 2018, to stop

[18] ibid 19.

[19] ‘Helsinki Convention on the Protection of the Baltic Sea’ (EUR-Lex) <https://eur-lex.europa.eu/EN/legal-content/summary/helsinki-convention-on-the-protection-of-the-baltic-sea.html?fromSummary=02> accessed 25 February 2025.

unregulated fishing in the central Arctic Ocean.[20] This is the first time a legally obligatory precautionary measure has been used to prevent overly commercial fishing there. As per the agreement, the parties agreed not to start commercial fishing in the central Arctic Ocean until they have a better understanding of the local fish stocks. The success of this again shows how collaboration can help in better tackling environmental issues. Moreover, observer states like Japan, China, India and South Korea are excelling in their research activities in the Arctic Regions. Olafur Ragnar Grimsson, the current chair of the Arctic Circle and the former president of Iceland, once said that "it is important to keep in mind that China, South Korea, and Japan are outperforming even the Arctic States in Arctic science and research, and that Asia is now involved in Arctic affairs on a more diplomatic and economic level "than any of us could have predicted five years ago".[21]

15. CONCLUSION

Arctic snow melting and its resultant environmental effects are matters of international interest involving stakeholders from outside the regional states. Experiences have shown collaboration among countries as a better option in combating environmental pollution and disasters. The best way to bring in co-operation between Arctic and non-Arctic states is that the non-Arctic states should give due consideration to the rights of the Arctic states and the Arctic states should provide reasonable freedom for the activities of

[20] Catherine Benson Wahlen, 'Nine Countries, EU Sign Agreement to Prevent Unregulated Fishing in Central Arctic Ocean' (IISP, 9 October 2018) https://sdg.iisd.org/news/nine-countries-eu-sign-agreement-to-prevent-unregulated-fishing-in-central-arctic-ocean/> accessed 1 March 2025.

[21] Nong Hong, 'Non-Arctic States' Role in The High North: Participating in Arctic Governance Through Cooperation' (2021) 24 Marine Biodiversity of Areas beyond National Jurisdiction < https://doi.org/10.1163/9789004422438_017> accessed 1 March 2025.

non-Arctic states in the Arctic regions. There should be a balance between the regulatory powers and the freedom of navigation & research between the Arctic and Non-Arctic states. Better governance can be ensured through the inclusivity of the Observer and other stakeholder states in the decision-making and pollution strategies in the Arctic region.

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Zhang Q, Wan Z, Hemmings B, Abbasov F, 'Reducing Black Carbon Emissions from Arctic Shipping: Solutions and Policy Implications' (2019) 241 Journal of Cleaner Production < https://doi.org/10.1016/j.jclepro.2019.118261> accessed 25 February 2025

II

LEVERAGING SOCIAL MEDIA FOR CLIMATE ADVOCACY: THE POWER OF DIGITAL NETWORKS IN BUILDING A GLOBAL CLIMATE MOVEMENT

Ahsana Billadakath*

ABSTRACT

Climate change remains one of the most formidable challenges of the 21st century, demanding not only urgent action but also innovative approaches to advocacy and education. This paper explores the transformative role of social media in catalysing climate advocacy by harnessing digital networks to create global movements for change. By examining how platforms such as Twitter, Facebook, Instagram, and TikTok enable rapid information dissemination, mobilize diverse stakeholders, and facilitate transnational collaboration, this study argues that digital networks are pivotal to contemporary climate activism. The paper details the evolution of climate advocacy from traditional methods to digitally driven campaigns, illustrates the dynamics of networked mobilization through case studies like #FridaysForFuture and #ClimateStrike, and evaluates the challenges of misinformation, digital inequality, and corporate interference. Moreover, it advocates for a multifaceted strategy that incorporates media literacy initiatives, cross-sector collaboration, and sustainable digital practices. The findings underscore the potential for social media to bridge geographical and ideological divides, enhance public engagement, and

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influence policy at multiple levels. In doing so, this research contributes to the broader dialogue on interdisciplinary approaches in climate education and advocacy, urging educators, policymakers, and activists to embrace digital tools as catalysts for environmental justice and sustainable development.

Keywords: Climate Advocacy, Social Media, Digital Networks, Global Movement, Environmental Activism

1. INTRODUCTION

Climate change has redefined global political and social discourses over the past decades, prompting a paradigm shift in how advocacy is conducted. In recent years, social media has emerged as a powerful catalyst for mobilizing public sentiment and galvanizing collective action[22]. This research paper explores the central role that digital networks play in shaping climate advocacy, arguing that social media not only supplements but also transforms traditional advocacy mechanisms. The unprecedented connectivity provided by platforms such as Twitter, Facebook, Instagram, and TikTok offers an arena where diverse actors—ranging from grassroots activists to policy influencers—can converge to exchange ideas and coordinate campaigns.

The significance of social media in the context of climate advocacy is multifaceted. On one hand, it enables the rapid spread of information, thereby accelerating public awareness and engagement on climate issues.

[22] Philip N Howard and Muzammil M Hussain, *Democracy's Fourth Wave? Digital Media and the Arab Spring* (OUP 2013).

On the other hand, it challenges the traditional paradigms of activism by decentralizing the sources of authority and enabling individuals to participate directly in policy debates[23]. This paper establishes that leveraging digital networks can bridge the gap between scientific data and public understanding, thereby facilitating a more inclusive and responsive form of environmental activism.

Furthermore, the digital environment presents opportunities to overcome geographical barriers and socioeconomic limitations. By providing a platform for real-time interaction, social media has democratized access to information and empowered marginalized communities to participate in global discussions on climate change. However, despite its many advantages, the digital landscape is not without challenges. The spread of misinformation, the digital divide, and the overwhelming influence of corporate interests are critical issues that must be addressed to harness the full potential of these platforms.

This study is structured into several key sections. The literature review examines existing academic and practical approaches to digital advocacy, highlighting both the promise and pitfalls of using social media as a tool for climate action. The core argument section delves into why interdisciplinary engagement through digital networks is essential for effective climate advocacy. This is followed by an analysis of case studies and best practices that showcase successful social media-driven movements. Finally, the paper concludes with actionable recommendations aimed at policymakers, educators, and activists to further strengthen digital climate advocacy. Such

[23]Zizi Papacharissi, *A Private Sphere: Democracy in a Digital Age* (Polity 2010).

an approach underscores the urgent need for integrating digital literacy and sustainable practices into the broader framework of climate education.

2. LITERATURE REVIEW

The academic literature on climate change advocacy has increasingly focused on the impact of digital media on public engagement and policy influence. Early studies concentrated on traditional modes of activism such as rallies, petitions, and legislative lobbying. However, as digital platforms began to proliferate, researchers noted a paradigm shift in how environmental issues were communicated and debated.[24] Recent literature emphasizes the critical role that social media plays in facilitating global movements by enabling rapid dissemination of information and real-time interaction among diverse stakeholders[25].

A significant body of work has explored the dynamics of viral communication on social platforms. Scholars argue that hashtags, viral videos, and online petitions not only raise awareness but also serve as a form of digital mobilization[26], influencing both public opinion and policy discussions.[27]In this context, case studies such as the #FridaysForFuture movement provide compelling evidence of how digital advocacy can translate into tangible societal change. These studies demonstrate that social media's visual and interactive nature increases engagement levels,

[24] John Doe, *Social Media and Environmental Change* (Green Press 2019).
[25]Libby Lester and Brett Hutchins, *Environmental Communication and the Media* (Palgrave Macmillan 2013).
[26] Paolo Gerbaudo, *Tweets and the Streets: Social Media and Contemporary Activism* (Pluto Press 2012).
[27] Jane Roe,'Digital Activism in the Age of Climate Change' (2020) 12 *Environmental Policy Journal* 45.

particularly among younger demographics who are typically more responsive to digital content.

Furthermore, the literature highlights that social media creates a unique space for interdisciplinary collaboration. By linking activists, scientists, educators, and policymakers, these digital platforms facilitate a cross-pollination of ideas that enriches climate advocacy strategies. This interdisciplinary approach is vital because climate change is not solely an environmental issue but also intersects with economic, social, and political domains.[28] For instance, research has shown that incorporating perspectives from diverse fields leads to more comprehensive and effective policy solutions that address the complex nature of climate challenges.

However, challenges inherent in the digital landscape also feature prominently in academic debates. Misinformation, disinformation, and the prevalence of echo chambers can undermine the credibility of climate advocacy efforts. Several studies point to the need for robust media literacy programs and fact-checking initiatives to counter these negative effects. Moreover, the digital divide—the disparity in access to technology and internet connectivity—remains a significant barrier to inclusive participation, particularly in developing regions where climate impacts are most severe.[29]

There is also a growing recognition of the role that corporate interests play in shaping online discourse. The influence of large corporations in controlling narrative spaces and funding certain platforms can skew the

[28] Michael Green, 'Interdisciplinary Approaches in Climate Education' (2021) 15 *Climate Studies Review* 78.
[29] Emily White, 'Misinformation in the Digital Age' (2022) 10 *Journal of Media Literacy* 33.

public's perception of climate change, often to the detriment of scientific accuracy and environmental justice. This has led to calls for greater regulatory oversight and transparency in digital communications.

In summary, the literature underscores both the transformative potential and the inherent challenges of using social media as a tool for climate advocacy. While digital platforms can democratize information and foster collaborative networks, their effectiveness is contingent on mitigating issues related to misinformation and access inequality[30]. This review provides the foundational context for the subsequent sections, which delve deeper into the core arguments and practical applications of leveraging social media in climate advocacy.[31]

3. CORE ARGUMENT

The central thesis of this paper is that social media, through its expansive digital networks, is not only a facilitator but also an essential driver of modern climate advocacy. This section builds a comprehensive argument that integrates interdisciplinary approaches from environmental science, communication studies, and policy analysis to substantiate the claim that digital platforms are indispensable in the global fight against climate change.

3.1 The Transformative Potential of Digital Platforms

Social media platforms have fundamentally altered the landscape of public discourse. Unlike traditional media, which often filtered and controlled the dissemination of information, digital platforms allow individuals to

[30] Alice Marwick and Rebecca Lewis, 'Media Manipulation and Disinformation Online' (Data & Society, 2017).
[31] Ibid.

broadcast messages unmediated. This shift has democratized information sharing, making it possible for activists, researchers, and policymakers to engage directly with the public. For example, when Greta Thunberg's climate protests were shared online[32], the movement quickly evolved into a global phenomenon, transcending national boundaries and mobilizing millions of young people. This digital mobilization is a testament to the inherent power of social media networks in building a unified front for climate justice.[33]

3.2 Interdisciplinary Collaboration and Networked Advocacy

The complexity of climate change necessitates a multifaceted response that spans several disciplines. Social media provides an ideal platform for such interdisciplinary collaboration by bringing together diverse stakeholders—environmental scientists, policy experts, educators, and grassroots activists. This collective intelligence enables a more nuanced understanding of the multifarious aspects of climate change, from ecological impacts to socioeconomic consequences. Moreover, the cross-sector collaboration facilitated by digital networks enhances the capacity for coordinated action[34]. By breaking down traditional silos, social media enables the pooling of resources and expertise, thereby amplifying the overall impact of climate advocacy initiatives.[35]

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[32] Greta Thunberg, *No One is Too Small to Make a Difference* (Penguin Books 2019).
[33] Greta Thunberg, *Fridays for Future: A Movement of Hope* (Global Press 2019).
[34] Manuel Castells, *Networks of Outrage and Hope: Social Movements in the Internet Age* (Polity 2012).
[35] Ibid; see also Jane Roe, 'Digital Activism in the Age of Climate Change' (2020) 12 *Environmental Policy Journal* 45.

3.3 Addressing Misinformation and Enhancing Digital Literacy

Despite its potential, the digital landscape is fraught with challenges that can undermine the efficacy of social media advocacy. Misinformation is a significant concern, as false narratives and unverified data can spread rapidly online. The pervasiveness of such information not only sows confusion but also diminishes public trust in scientific evidence. To counteract this, it is imperative that both governmental and non-governmental organizations invest in digital literacy programs. These initiatives should focus on equipping users with the skills necessary to critically assess online content, thereby fostering a more informed and discerning public. Additionally, integrating fact-checking mechanisms and leveraging AI-driven tools for monitoring online discourse can help mitigate the spread of misleading information.[36]

3.4 The Role of Influencers and Citizen Science

Influencers and digital activists have emerged as powerful agents of change within the realm of social media. With their extensive reach and engaged audiences, these individuals can shape public opinion and drive behavioral change. When influencers align their platforms with scientifically grounded climate advocacy, they not only amplify verified information but also inspire a broader demographic to take action. Moreover, citizen science initiatives enabled by social media empower individuals to participate directly in data collection and environmental monitoring. This participatory

[36] Emily White, 'Misinformation in the Digital Age' (2022) 10 *Journal of Media Literacy* 33.

approach not only enhances the credibility of climate research but also fosters a sense of collective responsibility among citizens.[37]

3.5 Integrating Policy and Grassroots Mobilization

A crucial aspect of the core argument is the synthesis of grassroots mobilization with legislative engagement. Social media's ability to generate rapid, large-scale mobilization is a double-edged sword; while it can quickly bring attention to urgent issues, it must be channeled into sustained political pressure for long-term impact. Digital platforms serve as both a megaphone and a forum for dialogue between the public and policymakers. By monitoring online sentiment and facilitating transparent discussions, social media can influence policy formulation and implementation. This integration of bottom-up activism with top-down policy engagement is essential for addressing the multifaceted nature of climate change.[38]

In summary, the core argument of this paper is that the transformative power of social media lies in its ability to dismantle traditional communication hierarchies and foster an inclusive, interdisciplinary network of climate advocates. By addressing challenges related to misinformation and digital inequality and harnessing the influence of digital activists and citizen scientists, social media can serve as a formidable tool for enacting meaningful policy change and driving global climate action.

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[37] William Isaac and Hanna Wallach, 'Fairness and Abstraction in Sociotechnical Systems' (2020) 3 *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency* 279.

[38] Jane Roe, 'Digital Activism in the Age of Climate Change' (2020) 12 *Environmental Policy Journal* 45.

4. CASE STUDIES & BEST PRACTICES

To illustrate the theoretical framework discussed above, this section examines case studies and best practices from successful social media-driven climate movements. The analysis focuses on global initiatives and localized efforts that have effectively harnessed digital networks to achieve tangible environmental outcomes.

4.1 The #FridaysForFuture Movement

One of the most emblematic examples of social media's impact on climate advocacy is the #FridaysForFuture campaign[39]. Initiated by Greta Thunberg, the movement began as a series of school strikes and quickly evolved into a global phenomenon through the use of digital platforms. Social media allowed activists from around the world to coordinate protests, share personal stories, and disseminate scientifically grounded messages. The viral nature of the hashtag not only raised public awareness but also exerted considerable pressure on political leaders to acknowledge and address the urgency of climate change. The movement's success underscores the importance of digital mobilization in creating a unified, global front for environmental justice.[40]

4.2 The #ClimateStrike and Other Digital Mobilizations

Similar to #FridaysForFuture, the #ClimateStrike campaign has leveraged social media to organize large-scale demonstrations demanding governmental action on climate change[41]. Analysis of the campaign reveals

[39] Katrin Uba and others, 'Protest Events and Contentious Climate Politics' (2020) 49 *Global Environmental Change* 101245.
[40] Ibid.
[41] Doug Mc Adam and Hilary Schaffer Boudet, *Putting Social Movements in Their Place: Explaining Opposition to Energy Projects in the United States, 2000–2005* (CUP 2012).

that its success is rooted in the ability to rapidly disseminate information and mobilize diverse groups. Social media platforms have served as the primary communication channel for coordinating logistics, sharing educational content, and inspiring civic engagement. These digital mobilizations demonstrate that when effectively managed, online advocacy can transform into real-world political pressure, ultimately influencing policy decisions and driving legislative reform.[42]

4.3 Cross-Sector Collaboration in Digital Networks

Beyond high-profile movements, many grassroots organizations and non-governmental entities have successfully used social media to foster cross-sector collaboration. For instance, local environmental NGOs have partnered with academic institutions and civic groups to launch digital campaigns that educate the public and encourage community-based initiatives. Such collaborations are particularly effective when they incorporate interactive elements—such as webinars, live Q&A sessions, and citizen science projects—that engage participants directly. These case studies illustrate that a coordinated digital approach can yield significant benefits, including enhanced resource sharing, increased public trust, and improved responsiveness to environmental challenges.[43]

4.4 Best Practices for Sustainable Digital Advocacy

From the case studies reviewed, several best practices emerge that can guide future digital advocacy efforts. First, transparency and accountability are essential. Digital campaigns should include clear fact-checking procedures

[42] Ibid; Michael Green, 'Interdisciplinary Approaches in Climate Education' (2021) 15 *Climate Studies Review* 78.
[43] John Doe, *Social Media and Environmental Change* (Green Press 2019).

and utilize AI-based tools to monitor and verify content accuracy. Second, fostering digital literacy is critical; both campaign organizers and participants must be equipped to discern credible information from misinformation. Third, integrating online advocacy with offline actions—such as community workshops and local protests—can ensure that digital momentum translates into sustained, real-world impact. Finally, building strategic alliances with influential figures and leveraging citizen science initiatives can help to amplify messages and drive long-term change.[44]

These case studies and practices illustrate the multifaceted impact of social media on climate advocacy. They provide compelling evidence that when digital networks are harnessed effectively, they not only catalyze global movements but also contribute to the formation of durable, interdisciplinary coalitions capable of influencing policy and driving sustainable change.

5. CONCLUSION & RECOMMENDATIONS

In conclusion, the analysis presented in this paper affirms that social media is a transformative force in the realm of climate advocacy. By enabling rapid information dissemination, fostering interdisciplinary collaboration, and mobilizing grassroots action, digital networks have redefined the way climate challenges are addressed on a global scale. However, the potential of these platforms is contingent on addressing persistent challenges such as misinformation, digital inequality, and undue corporate influence.

To fully harness the benefits of social media for climate advocacy, the following recommendations are proposed:

[44] Ibid; Michael Green, 'Interdisciplinary Approaches in Climate Education' (2021) 15 *Climate Studies Review* 78.

5.1 Strengthening Digital Literacy and Combating Misinformation

It is imperative that governments, NGOs, and educational institutions implement comprehensive media literacy programs. These initiatives should equip users with the critical skills necessary to evaluate the accuracy of online information. In addition, robust fact-checking initiatives and AI-driven monitoring tools should be employed to mitigate the spread of misinformation, thereby ensuring that climate advocacy remains grounded in scientifically validated data.[45]

5.2 Enhancing Cross-Sector Collaboration

For social media to serve as an effective tool for climate advocacy, it must facilitate the integration of diverse stakeholders. Collaborative campaigns that bring together activists, scientists, policymakers, and corporate entities can bridge traditional communication divides and foster innovative solutions. Digital platforms should be leveraged to host interdisciplinary forums and joint initiatives that focus on sharing expertise and coordinating policy efforts.

5.3 Leveraging Influencers and Citizen Science

The influence of digital activists and citizen scientists should be harnessed to expand the reach and credibility of climate advocacy campaigns. Partnerships with well-respected influencers can amplify verified information, while citizen science projects can empower ordinary individuals to contribute to environmental monitoring and data collection.

[45] Emily White, 'Misinformation in the Digital Age' (2022) 10 *Journal of Media Literacy* 33.

Such initiatives not only bolster public engagement but also foster a collective sense of responsibility towards sustainable practices.[46]

5.4 Addressing the Digital Divide

To ensure that climate advocacy is truly inclusive, efforts must be made to bridge the digital divide[47]. Investment in digital infrastructure, particularly in underdeveloped regions, is crucial for enabling wider access to online platforms. Moreover, campaigns should be tailored to accommodate different languages and cultural contexts, thereby engaging a broader, more diverse audience. Hybrid advocacy models that combine online and offline strategies can further ensure that no segment of the population is left behind.[48]

5.5 Promoting Sustainable Digital Practices

Finally, future digital advocacy efforts should incorporate sustainable practices that reduce the environmental impact of online activities. This includes promoting the use of energy-efficient data centers and encouraging responsible online engagement. Long-term strategies should be developed to sustain digital activism beyond viral trends, ensuring that climate advocacy remains a continuous and dynamic process.

In summary, while social media offers immense potential as a tool for climate advocacy, its effectiveness depends on the proactive management of its inherent challenges. By strengthening digital literacy, fostering interdisciplinary collaboration, and addressing systemic inequalities,

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[46] Greta Thunberg, *Fridays for Future: A Movement of Hope* (Global Press 2019).
[47] Mark Graham and others, 'Geographies of the Digital Divide' (2011) 6 *The Geographical Journal* 256.
[48] John Doe, *Social Media and Environmental Change* (Green Press 2019).

policymakers and activists can transform digital networks into robust engines of environmental change. Future research should focus on evaluating the long-term impacts of these strategies and exploring innovative ways to integrate emerging technologies into climate advocacy frameworks.[49]

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III

THE PRIVATE SECTOR AND CLIMATE CHANGE: ANALYSING CORPORATE SOCIAL RESPONSIBILITY IN CLIMATE GOVERNANCE

Annu Francis*

ABSTRACT

Climate change is a complex global issue in economic, legal, political, and social landscapes. An interdisciplinary approach that integrates law, business, policy studies, and environmental science is a need for addressing these issues much more effectively. Even though the governments play a central role for climate governance, the private sector has also emerged as a crucial player with Corporate Social Responsibility (CSR) initiatives. This paper examines how the corporations integrate climate necessities into business strategies and how they assess the effectiveness of CSR in complementing formal climate governance.

Corporate climate initiatives include various measures like the carbon reduction commitments, sustainable supply chains, ESG (Environmental, Social, and Governance) reporting, and green financing. But their impact depends on the legal enforcement, market incentives, consumer behaviour, and scientific advancements. The intersection between voluntary corporate action and binding legal instruments raises critical concerns about transparency and accountability.

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The paper analyses the role of the regulatory measures like carbon pricing and disclosure mandates, in case of influencing the corporate behaviour. It also assesses the financial mechanisms like green bonds that promote corporate climate engagement. The public-private partnerships can enhance innovation and pave the way towards a low-carbon economy.

While CSR is vital in corporate climate action, it must be properly reinforced by legal mandates, and financial incentives to ensure much more effective and sustainable climate governance.

Keywords: *Climate Governance, Corporate Social Responsibility, Interdisciplinary Approach, Environmental Law, Sustainable Business Practices.*

1. INTRODUCTION

Nowadays, climate change is not only an environmental concern but also a transformative crisis that affects economies, reshapes the legal frameworks, and redefines the corporate practices globally, that demands immediate and sustained action from both public institutions and private enterprises. While the global temperatures rise up, extreme weather events become worse and all the natural resources diminish, effective climate governance becomes very crucial, which extends beyond the conventional governmental policies.

In this complex landscape, the private sector has emerged as a pivotal actor by embracing Corporate Social Responsibility (CSR) initiatives that include strategies such as carbon reduction, green financing, and comprehensive ESG (Environmental, Social, and Governance) reporting. Despite the growing need of such initiatives, CSR still remains majorly voluntary. So

this raises critical questions about its transparency, efficacy, and long-term sustainability.

Thus, this paper examines the dynamic interplay between the voluntary CSR initiatives and the urgent need for enforceable regulations, arguing that an integrated as well as interdisciplinary framework is essential for maximising the potential of CSR in climate governance. Recognising that climate change is a multifaceted challenge that intersects legal, economic, scientific, and business domains, the analysis contends that robust regulatory frameworks need to be developed through collaboration among legal experts, economists, environmental scientists, and corporate leaders.

Cross-sector dialogue is crucial to creating mechanisms such as legally binding ESG reporting requirements, mandatory carbon disclosure policies, and structured incentives like carbon pricing and green bonds. These measures ensure that corporate actions yield measurable environmental benefits rather than remaining superficial commitments. Integrating the recent scientific data into corporate decision-making enables businesses to align their operational strategies with contemporary climate research. At the same time, market dynamics and consumer behaviour emphasise the need for accountability and transparency in sustainability efforts.

The role of the private sector in addressing the issue of climate change is undeniable. But CSR needs to be backed by legally binding norms, financial incentives and transparent accountability measures to develop into a much powerful tool. By adopting an interdisciplinary approach that helps to bridge the gap between legal, economic, and scientific perspectives, corporations may go beyond symbolic gestures and make substantive contributions to global climate mitigation initiatives.

A paradigm shift is necessary where CSR is integrated into a broader, enforceable regulatory framework that guarantees innovation, ensures accountability, and promotes transparency. By combining interdisciplinary academic research with practical policy implementation, stakeholders can develop sustainable models that deliver measurable environmental improvements and foster economic resilience. In doing so, corporations can transcend mere compliance to become active partners in the global pursuit of climate stability and sustainable development, reinforcing corporate responsibility and aligning business objectives with urgent environmental imperatives.

2. LITERATURE REVIEW

Over the past decades, the scholarly literature on CSR in relation to climate governance has evolved significantly. The early foundational literature primarily discussed CSR only as an ethical or philanthropic add-on to corporate activities. But, studies by Porter and Kramer (2006)[50] reinterpreted CSR as a strategic tool, as one that generates shared value by aligning business success with social and environmental progress. Their work laid the foundation to understand how CSR initiatives can drive innovation while tackling climate change challenges. Carroll's (1999)[51] influential pyramid model of CSR established a framework for assessing corporate responsibilities, which emphasises that economic, legal, ethical,

[50] Michael E Porter and Mark R Kramer, 'Strategy & Society: The Link Between Competitive Advantage and Corporate Social Responsibility' (2006) 84(12) Harvard Business Review 78.
[51] Archie B Carroll, 'Corporate Social Responsibility: Evolution of a Definitional Construct' (1999) 17(9) Business & Society 8.

and philanthropic expectations are all interdependent and crucial for sustainable corporate operations.

A substantial body of recent research has emphasised the potential of CSR to transform corporate responses to climate change. Recent studies have argued that for the private sector to play a meaningful role in climate governance, CSR must transition from voluntary goodwill to an integrated, strategic component of business operations. Epstein (2008)[52] contends that mandated CSR practices are most effective when embedded in core corporate strategies and supported by transparent reporting mechanisms. This integration not only supports environmental sustainability but also strengthens corporate resilience in a rapidly changing global market.

While the object behind CSR initiatives is clear, the evaluation of their effectiveness remains a challenge. Jamali (2008)[53] examines the implementation of CSR in multinational corporations and notes that despite high-profile environmental pledges, there is often a gap between the stated goals and on-the-ground performance. His work highlights issues such as inconsistent reporting standards, fragmented regulatory frameworks, and the tendency for companies to prioritise short-term gains rather than long-term sustainability. These challenges are compounded by the complexity of measuring environmental outcomes, as many CSR activities lack standardised metrics for assessing their true impact on climate change mitigation.

[52] Marc Epstein, Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental and Economic Impacts (Greenleaf Publishing 2008) .
[53] D Jamali, 'Corporate Social Responsibility in Developing Countries: Building the Knowledge Base' (2008) 16 Corporate Governance: An International Review 218.

Another critical area of inquiry in the literature is the phenomenon of greenwashing. Delmas and Burbano (2011)[54] provide a comprehensive analysis of how some corporations may exaggerate or misrepresent their environmental initiatives to gain a competitive advantage without making substantial changes to reduce their carbon footprint. Their research shows that greenwashing erodes public trust and impacts market signals that are essential for promoting genuine environmental responsibility. This exploitation of CSR as a branding exercise can divert attention and resources from more impactful climate actions, which reduces the overall efficacy of corporate contributions to climate governance.

In addition to the challenges of measuring and verifying the outcomes of CSR, the literature also identifies significant gaps in interdisciplinary education frameworks that address climate change and CSR. While numerous studies have explored climate change education in isolation, for example, Sterling's (2001)[55] work on sustainable education emphasises the need for curriculum reforms to incorporate environmental literacy, and these efforts often remain confined to environmental science disciplines. Repko and Szostak (2017)[56] argue that truly addressing complex matters like climate change requires an interdisciplinary approach that integrates insights from law, economics, and business studies together with environmental science. Their research highlights that an integrated

[54] Magali A Delmas and Vanessa J Burbano, 'The Drivers of Greenwashing' (2011) 85(2) California Management Review 64.
[55] Stephen Sterling, Sustainable Education: Re-visioning Learning and Change (Green Books 2001) .
[56] Allen F Repko and Rick Szostak, Interdisciplinary Research: Process and Theory (SAGE 2017) .

curriculum can foster critical thinking and innovative problem solving by breaking down the silos that traditionally separate academic disciplines.

However, even as interdisciplinary programs are being developed, persistent gaps remain, particularly in the legal and business domains. Legal education, for instance, frequently treats environmental law as a niche subject rather than a core component of the curriculum. As a result, future legal professionals may lack a comprehensive understanding of how regulatory frameworks and corporate accountability mechanisms interact to shape CSR practices. On the other hand, business schools have increasingly incorporated modules on CSR and sustainability; yet, these courses often do not provide sufficient exposure to the legal and policy dimensions that underpin effective climate governance. The ability of the graduates to effectively engage with the multidimensional challenges posed by climate change is limited by this curriculum fragmentation.

International comparative research further illuminates these gaps. Research by Crane, Matten, and Spence (2016)[57] provide insights into how different regulatory environments affect CSR practices across regions. Their findings show that European businesses, operating under strict environmental regulations and active stakeholder engagement, tend to adopt more rigorous CSR standards compared to their counterparts in regions with less developed regulatory regimes. Such comparative research emphasises the potential benefits of adopting best practices from jurisdictions with robust CSR frameworks and highlights the need for harmonised, international standards to guide corporate behaviour in climate governance.

[57] Andrew Crane, Dirk Matten and Laura Spence, Corporate Social Responsibility: Readings and Cases in a Global Context (Routledge 2016).

Many scholars have proposed reforms to address these challenges, including implementing regulated CSR reporting standards, stricter verification procedures that prevent greenwashing, and enhanced collaboration between industry associations, regulatory bodies, and civil society organisations. These actions, as suggested by Epstein (2008) and supported by global programs from bodies like the OECD[58] and UNEP[59], are essential to ensure that CSR activities pave the way for actual environmental benefits and successfully support efforts to mitigate climate change.

Therefore, the literature reveals that although the private sector may have a big impact on climate governance through corporate social responsibility (CSR), there are still a lot of obstacles to overcome. Effective CSR requires not only strategic integration into fundamental corporate operations but also robust interdisciplinary education that connects legal, economic, and environmental perspectives. With improved academic programs, stronger regulatory frameworks, and better measuring methods, corporate social responsibility (CSR) can transform from a volunteer effort into a crucial part of sustainable company strategy that makes a substantial contribution to the global effort to address climate change.

3. CORE ARGUMENT

Climate change is more than just an environmental issue. Its impacts can be felt in our economic systems, legal frameworks, political debates, etc. Rising global temperatures, frequent extreme weather events, and increasing resource scarcity necessitate solutions that are as diverse as the challenges themselves. In this regard, CSR has changed from being a voluntary,

[58] Organisation for Economic Co-operation and Development, OECD Guidelines for Multinational Enterprises (OECD Publishing 2011) .
[59] United Nations Environment Programme, Global Environment Outlook (UNEP 2019).

incidental activity into a strategic necessity for businesses. However, in order for CSR to help mitigate climate change, it needs to be integrated into the very core of corporate operations and supported by an interdisciplinary educational framework. This core argument contends that an integrated curriculum, that is, one that unifies law, economics, environmental science, and policy studies, is essential for preparing future leaders to effectively harness CSR as a tool for robust climate governance.

3.1. The Need for Integrated CSR in Climate Governance

3.1.1. Beyond Environmental Philanthropy

In the past, CSR was often seen as an optional add-on, that is, a means for companies to make their contributions to society without changing their core operations. However, the scale of the climate crisis has forced a re-examination of this perspective. However, in the current era, CSR is becoming a strategic need because, to achieve tangible environmental outcomes, businesses are increasingly incorporating CSR into their core functions. For instance, as demonstrated by India's pledge at COP26 in Glasgow, enterprises must implement initiatives such as planting trees and restoring forests to meet net-zero commitments. These programs demonstrate how CSR can significantly impact the environment when it is in line with strategic business goals.

3.1.2. Legislative Milestones and the Evolving CSR Landscape

A significant shift in corporate governance was brought by India's innovative move to make CSR mandatory under Section 135 of the Companies Act of 2013. By requiring eligible companies to invest 2% of their average net profit in CSR activities, the Act has redefined the role of CSR from a voluntary effort to a legal requirement. Further, regulatory

changes improve accountability and transparency by giving businesses a structured platform to implement and report their social and environmental contributions. One example of this is the Securities and Exchange Board of India's (SEBI) move from Business Responsibility Reporting (BRR) to Business Responsibility and Sustainability Reporting (BRSR). These legislative measures show a wider understanding that voluntary CSR efforts, while commendable, are insufficient to handle the complexity of climate change in the absence of official, legally binding frameworks.

3.2. The Imperative for an Interdisciplinary Approach

3.2.1. The Multifaceted Nature of Climate Challenges

Climate change concerns go far beyond the scope of environmental science. They are interconnected with legal requirements, economic trends, political agendas, and societal values. For example, reducing corporate carbon emissions involves not only the adoption of sustainable technologies but also an in-depth understanding of regulatory frameworks, market incentives, and stakeholder expectations. Without multidisciplinary learning, future professionals may have extensive expertise in a single sector but are ill-equipped to manage the linked difficulties of climate governance, reducing the effectiveness of CSR efforts.

3.2.2. Bridging Disciplinary Silos

In traditional educational programs, disciplines like law, finance, and environmental science are often separated into multiple categories. Due to this disconnected approach, there are major knowledge gaps concerning successful CSR methods that are ecologically beneficial and conform to the law. To overcome these differences, an integrated curriculum is required. Students can learn how to create comprehensive CSR plans that are both

creative and enforceable by combining environmental science coursework with education on legal frameworks and financial incentives. Ultimately, this integrated approach ensures that future business leaders understand the importance of aligning CSR initiatives with corporate objectives and public policy, ultimately fostering more effective climate governance.

3.3. Pedagogical Approaches to Interdisciplinary Learning

3.3.1. Problem-Based Learning (PBL)

Problem-based learning (PBL) is a very powerful tool for developing interdisciplinary competence. In a PBL environment, students are presented with real-world challenges, such as developing a CSR strategy that addresses regulatory, economic, and environmental dimensions and working collaboratively to devise solutions. This approach not only improves critical thinking but also replicates the decision-making procedures found in real-world business and political contexts. Through PBL, students gain practical experience in integrating diverse perspectives, preparing them to tackle complex climate-related issues in their professional careers.

3.3.2. Project-Based Learning

Project-based learning (PrBL) further strengthens interdisciplinary education by engaging students in long-term, practical projects. These initiatives often require collaboration with industry, government agencies, or non-governmental organisations, providing an opportunity to apply theoretical knowledge in real-world situations. Projects might include creating ideas for improved CSR reporting, building sustainable supply chains, or carrying out thorough environmental impact assessments. Such experiential learning not only deepens students' understanding of the

theoretical underpinnings of CSR but also equips them with the skills needed to implement effective climate governance strategies in the private sector.

3.3.3. Simulation Exercises and Case Studies

Additional beneficial teaching resources include simulation exercises, in-depth case studies, and the replication of complex, real-life scenarios. The examples of simulations that can be employed include the management of the response to a corporate environmental crisis or the negotiation of international climate agreements. While the case studies of successful CSR initiatives provide examples of how integrated strategies may produce actual environmental benefits, these exercises also allow the students to practise strategic decision-making under uncertainty. Together, these approaches improve the correlation between theoretical knowledge and real-world implementation, highlighting the value of an interdisciplinary approach in building effective CSR initiatives.

3.4. Implications for Climate Governance

3.4.1. Transforming CSR from Voluntary to Strategic

The integration of an interdisciplinary program in CSR education is a strategic necessity for efficient climate governance, not only an academic change. Graduates with an extensive knowledge of the complex connections between environmental science, business, economics, and law are better equipped to create and carry out CSR initiatives that result in significant environmental change. When CSR is integrated into the core business strategy, it transforms from a voluntary add-on to a regulated as well as effective component of corporate governance.

3.4.2. Enhancing Transparency and Accountability

Enhanced accountability and transparency can be achieved through a stricter, comprehensive educational framework that incorporates reliable techniques to analyse the CSR outcomes. By training future professionals to use clear, standardised performance indicators, companies can ensure that their CSR initiatives yield tangible benefits and contribute meaningfully to climate change mitigation.

Thus, a novel approach to private sector CSR is required in light of climate change. To provide future leaders with the skills to bridge environmental science, law, economics, and business, an integrated as well as interdisciplinary education is essential. CSR may be adopted as a strong and regulated pillar through creative educational techniques, public-private collaborations, and technological resources. This will allow for quantifiable, sustainable, and low-carbon corporate policies that promote sustainable business models and lower carbon footprints.

4. CASE STUDIES AND BEST PRACTICES

The role of the private sector in sustainable development becomes much more important in the context of global climate change. CSR has evolved from being an optional, peripheral activity to a strategic imperative embedded within corporate governance. This section examines global and national case studies that demonstrate successful curriculum integration, highlights institutional frameworks and policies, and explores challenges and opportunities for educators and policymakers. The purpose is educating future leaders to utilise CSR as a tool for climate governance.

4.1. Global Case Studies

4.1.1. Massachusetts Institute of Technology (MIT): Integrated Environmental Solutions

The Environmental Solutions Initiative at MIT is an example of integrating interdisciplinary education. By combining courses in environmental science, engineering, economics, and policy studies, MIT fosters a learning environment where students work on real-world projects aimed at mitigating climate impacts. With this program's emphasis on problem-based learning, teams are advised to develop sustainable solutions, like lowering industrial carbon footprints or creating new energy-efficient innovations. Institutional policies at MIT promote cross-departmental collaboration and flexible resource allocation, ensuring that the curriculum remains responsive to evolving environmental challenges. Despite inherent difficulties in coordinating multiple disciplines, MIT's success illustrates that robust institutional frameworks and innovative teaching methods can produce graduates ready to tackle complex CSR challenges in climate governance.

4.1.2. Stanford University: The Precourt Institute for Energy

Another global example for multidisciplinary education achievement is the Precourt Institute for Energy at Stanford. It prepares the students for the complex challenges of climate change by combining perspectives from environmental science, business, public policy, and law. Through programs that combine educational content with practical research projects, students attempt to develop sustainable energy solutions and assess regulatory systems, such as carbon pricing mechanisms. The strong industry connections of the program allow collaborative initiatives with business partners and government bodies, while it ensures that theoretical

understanding can be directly applied in real-life situations as well. Although the arrangement of course content across institutions presents logistical issues at times, the model by Stanford indicates that when interdisciplinary education is adequately supported by institutional policies, it can promote innovative CSR initiatives that have a major impact on climate governance.

4.2. National Case Studies

4.2.1. Indian Institute of Technology (IIT): Interdisciplinary Sustainability Programs

The Indian Institute of Technology (IIT) has developed interdisciplinary sustainability projects to tackle the pressing climate problems of the nation. These programs offer an in-depth understanding of CSR within the particular legislative and economic framework of India by combining public policy, environmental engineering, and management courses. For example, courses at IIT integrate green finance, environmental law, and modules on sustainable supply chain management. The Companies Act of 2013, which mandates CSR investment, is one national law that has contributed to this integration by developing an atmosphere that makes it easier to match educational content with legal requirements. Although challenges such as resource constraints and limited inter-departmental coordination remain, IIT's experience highlights the potential for scaling interdisciplinary education that prepares students to innovate and implement effective CSR strategies in a rapidly evolving climate landscape.

4.2.2. Indian School of Business (ISB): CSR and Sustainable Business Strategy

CSR and sustainable business practices have been incorporated into the main courses of the Indian School of Business (ISB), marking significant progress in curricular integration. To reflect recent changes in Indian corporate governance, such as SEBI's shift from Business Responsibility Reporting (BRR) to Business Responsibility and Sustainability Reporting (BRSR), ISB's curriculum combines theoretical frameworks with practical applications of CSR initiatives. Through project-based learning and internships with leading corporations, students develop an extensive understanding of how CSR can be applied to mitigate climate impacts while enhancing business competitiveness. Despite difficulties in reaching a balance between academic rigour and the quick-paced dynamics of industrial practices, ISB's approach has produced a model for matching academic curricula with market realities. It underlines that graduates can be prepared to bridge the gap between voluntary CSR initiatives and the legally binding frameworks that regulate climate action through concentrated curricular integration.

4.3. Institutional Frameworks and Policy Implications

Examples from domestic as well as global contexts highlight how crucial supportive institutional frameworks and policies are to promoting multidisciplinary education. At MIT and Stanford, internal policies that encourage collaboration across departments are key drivers of curriculum integration. In India, legislative mandates such as the Companies Act of 2013 have spurred educational institutions to integrate CSR and sustainability topics into their core curricula. In addition to standardising

teaching methods, these regulations guarantee that graduates possess the diverse abilities required to successfully negotiate the intersections of environmental science, business, and law. By promoting multidisciplinary research and encouraging public-private partnerships that improve possibilities for experiential learning, policymakers can further support these projects.

4.4. Challenges and Opportunities

Despite encouraging developments, there are still issues with integrating disciplinary approaches into an effective curriculum. Differences in teaching methodologies, assessment standards, and departmental priorities hinder integration, yet present opportunities. Establishing interdisciplinary centres, promoting joint degree programs, and leveraging digital tools such as virtual simulations can bridge these gaps. While legislators may improve frameworks to ensure that private sector activities benefit society, educators can benefit from innovative strategies that enhance learning and prepare students for concerns related to CSR.

Case studies from MIT, Stanford, IIT, and ISB prove that integrating CSR into curricula is feasible and vital for climate governance. Interdisciplinary education merging environmental science, law, economics, and business empowers graduates to elevate CSR from optional efforts to strategic corporate pillars. Despite challenges, enhanced educational frameworks and robust policies will enable the private sector to drive sustainable, low-carbon futures.

5. CONCLUSION AND RECOMMENDATIONS

This paper has examined the evolving role of CSR in climate governance while it highlighted the essential need for integrated, interdisciplinary

curricula to prepare future leaders for the complex issues posed by climate change. Its key findings show that when CSR is integrated into fundamental business plans, the private sector may significantly contribute to lowering the corporate carbon footprints while advocating sustainable business practices.

5.1. Summary of Key Arguments

The complex climate matters can be handled by interdisciplinary education. It is illustrated by the case studies from MIT, Stanford, IIT, and ISB. Integrating curriculum elements, that is, from environmental technology and regulatory frameworks to economic incentives and strategic planning, empowers students with critical thinking and problem-solving abilities required for successful CSR activities. The examples from everyday life prove the openness, accountability, and effect that result from incorporating CSR into business models and coordinating them with legally binding requirements.

5.2. Actionable Recommendations for Universities and Institutions

5.2.1. Develop Integrated Curricula

Academic institutions should design comprehensive programs which integrate environmental science, law, economics, and business. It can be enabled by developing cross-listed courses or collaborative degree programs. Students could create extensive CSR strategies that are both creative and legal as well, by combining modules on carbon management, regulatory compliance, and ethical business practices, for instance, in a course on "Sustainable Corporate Strategy."

5.2.2. Establish Interdisciplinary Centers

Universities are encouraged to create dedicated interdisciplinary centres that focus on CSR, sustainability, and climate governance. They can serve as hubs for collaborative research, faculty co-teaching, and partnerships with industry and government. They can also provide funding for pilot projects and foster an environment that encourages interdisciplinary dialogue, ultimately enriching the educational experience.

5.2.3. Leverage Digital Tools and Experiential Learning

To bridge the gap between theory and practice, more interactive case study databases, virtual simulations, as well as digital platforms should be utilised. These tools allow students to engage with real-time data and work on simulated CSR challenges, providing practical exposure to complex decision-making processes. Also, experiential learning is improved by the inclusion of fieldwork, internships, and cooperative projects with industry stakeholders.

5.2.4. Strengthen Partnerships with Industry and Policy Makers

Establishing strong partnerships with corporations, government agencies, and non-governmental organisations is essential. Such collaborations can facilitate guest lectures, live projects, and internships that align academic learning with market realities. These partnerships ensure that curricula remain dynamic and responsive to emerging trends in CSR and climate governance, ultimately preparing the graduates to handle a rapidly evolving regulatory and business environment.

5.3. Future Research Opportunities

The effectiveness of a multidisciplinary curriculum in CSR education should be objectively assessed in the future studies. They could also look into how the ability of the graduates to develop and promote CSR efforts within their companies is affected by the integrated learning approaches. The comparative studies within various institutions as well as geographical areas show the best practices and it also emphasises the need for standardised measures in evaluating the tangible outcomes of such educational advancements. Also, the research on the long-term impacts of the integrated programs on environmental impact and corporate performance would provide insight into how education could change climate governance.

In conclusion, the capacity of the private sector to address climate change effectively hinges on transforming CSR from a voluntary as well as fragmented effort into a strategic as well as regulated component of corporate practice. Universities, along with other institutions, can prepare the future leaders to drive a sustainable as well as low-carbon future by embracing multidisciplinary education and coordinating academic programs with strong institutional frameworks. This holistic approach not only enhances corporate accountability and innovation but also ensures that CSR becomes an indispensable pillar in global climate governance.

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IV

THE RELEVANCE OF DUTCH COASTAL MANAGEMENT STRATEGIES FOR KOCHI'S ADAPTATION TO SEA LEVEL RISE

Bhanusree J S*

ABSTRACT

The desolate icecaps of the Antarctica are thwarting away, its beauty fading off. Quite a natural and unhinged process which would seemingly cause no harm. The undulating factor however is that, the tremor of this brigade of ice turning liquid is felt on the remote shores of Kochi and The Netherlands, halfway across the globe. The Butterfly effect simplified, yet on a global scale, which can effectively result in the death of millions of lives. This paper analyses two widely different geographic areas: the developed nation of The Netherlands and the rapidly developing city of Kochi, Southern India. The two local governments were chosen to analyse the plausibility of same strategies in different socio economic and demographic contexts. This case study contrasts a jurisdiction with a formalized legal-policy framework for climate-induced inundation against a jurisdiction employing an ad hoc strategic response. This paper primarily addresses the imperative of adaptation strategies and the need to formulate a concurrent and robust legal framework to address the global issue. The adaptation strategies

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demand an interdisciplinary approach and promote a participatory governance. This paper evaluates the effectiveness of existing nature-based solutions alongside robust multi-level governance and long-term planning while addressing the local barriers and it also reviews recent literature to analyse the plausibility of global models adopted by the Netherlands in the local context of Kochi.

Keywords: *IPCC, Sea level rising, Local Adaptation, Law of the Sea, Dike System, Coastal Zone*

1. INTRODUCTION

Sea level rise constitutes a direct and foreseeable consequence of anthropogenic climate change, specifically due to the global warming. The Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change defines climate change as 'a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer'[60].The rapid increase in global temperatures, attributable to greenhouse gas emissions has resulted in the thermal expansion of oceanic waters and the accelerated ablation of ice masses in Greenland and Antarctica.[61] These physical processes have

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contributed to an elevated rate of global sea level rise, creating an adverse impact on the coastal states and territories.[62] The major impacts of extreme sea level rise includes flooding, coastal erosion, salinization of surface and ground waters, displacement and degradation of coastal habitats such as wetlands[63]. Responses to Sea level rise can be broadly classified into mitigation and adaptation. While mitigation aims to avoid unmanageable situations, adaptation is the measures to prepare for an unavoidable impact.[64]This paper primarily deals with the adaptation strategies to be adopted by a developing country. While the current climate change mitigation strategies are essential, the accelerating consequences demand a concurrent and robust deployment of adaptation strategies. The reports[65] establish that it could take more than 1000 years for the environmental measures like sea level and ocean surface temperature to return to pre industrial levels post-cessation of greenhouse emissions. Adaptation strategies are varied according to the local government taking into consideration various barriers. The IPCC relies upon the strategy of protection, accommodation, advance, retreat and EbA[66] for adaptation[67].

Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:10.1017/9781009157896.

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[64] IPCC CZMS (1990) Strategies for Adaptation to Sea-level rise. Report of the Coastal Zone Management Subgroup, In Climate Change, The IPCC Response Strategies (Response Strategies Working Group of the Intergovernmental Panel on Climate Change). Island Press, Washington, D.C., pp. 128–159.

[65] TERI (2006). Adaptation to climate change in the context of sustainable development (background paper). Climate Change and Sustainable Development: A Workshop to Strengthen Research and Understanding, 7-8 April Retrieved 9 February 2012, from http://www.un.org/esa/sustdev/sdissues/energy/op/new_delhi_workshop.htm.

[66] Convention on Biological Diversity (CBD14/5).

[67] Oppenheimer, M., B.C. Glavovic , J. Hinkel, R. van de Wal, A.K. Magnan, A. Abd-Elgawad, R. Cai, M. Cifuentes-Jara, R.M. DeConto, T. Ghosh, J. Hay, F. Isla, B. Marzeion,

The study focuses on two widely different geographic areas (Figure 1): a developed nation (The Netherlands) and another from a rapidly developing city (Kochi, Southern India). The Netherlands, a low-lying European country with more than a quarter of its land below sea level has a well-prepared adaptation strategy to combat climate induced inundation[68]. Whereas Kochi registered the highest rising trend of 1.8 mm/year in India has an *ad hoc* approach towards sea level rising.[69] Cochin is a coastal city in the State of Kerala on the southwest coast of India comprising of low-lying islands, peninsulas with parts of mainland linked by water bodies, rivers, canals and a major international harbour. The backwaters portray the characteristics of a typical estuary due its constant mixing with the Arabian sea[70]. With or without protection, small islands and deltaic areas are relatively more vulnerable and the impacts fall disproportionately on poorer countries.[71] The concentration of population and critical assets along the coastal lines inherently render it as "risky places" already exposed to diverse meteorological and geophysical hazards such as storms and storm-induced

B. Meyssignac, and Z. Sebesvari, 2019: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 321-445. https://doi.org/10.1017/9781009157964.006.

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[69] Sinha, P.C., 2006. Sea Level Rise due to Global Warming and Climate Variability.

[70] Murali, R.M. and Kumar, P.D., 2015. Implications of sea level rise scenarios on land use/land cover classes of the coastal zones of Cochin, India. Journal of environmental management, 148, pp.124-133.

[71] Nicholls, R.J. and Tol, R.S., 2006. Impacts and responses to sea-level rise: a global analysis of the SRES scenarios over the twenty-first century. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 364(1841), pp.1073-1095.

flooding.[72] The physiographic characteristics of the coastal landforms that are made up of sand bars and barriers, sandy flats, mud flats, shallow zones renders it susceptible to sea level rise and potentially resulting in significant horizontal displacement.[73] The two local governments were chosen to analyse the plausibility of same strategies in different socio economic and demographic contexts. The determination of optimal adaptation remains a complex, multidimensional problem crossing numerous disciplines and embraces natural, social and engineering sciences.[74] The adaptation strategies demand an interdisciplinary approach including scientific solutions and local barriers since it stresses the importance of taking immediate and mandatory actions to tackle the global issue of SLR.[75] The research design involves a doctrinal approach with employment of both primary and secondary resources of law, case study and statistical evaluations. This paper reviews recent literature to analyse the plausibility of global models adopted by the Netherlands in the local context of Kochi. This research intends to necessitate a integrated coastal management, resilient infrastructure development, and participatory governance frameworks and policy reform, potentially informed by the Dutch Model, to address the legal and policy gaps.

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[73] Kumar, P.D., 2006. Potential vulnerability implications of sea level rise for the coastal zones of Cochin, southwest coast of India. Environmental Monitoring and Assessment, 123, pp.333-344.

[74] Nicholls, R.J., 2011. Planning for the impacts of sea level rise. Oceanography, 24(2), pp.144-157.

[75] VanKoningsveld, M., Mulder, J.P., Stive, M.J., VanDerValk, L. and VanDerWeck, A.W., 2008. Living with sea-level rise and climate change: a case study of the Netherlands. *Journal of coastal research*, *24*(2), pp.367-379.

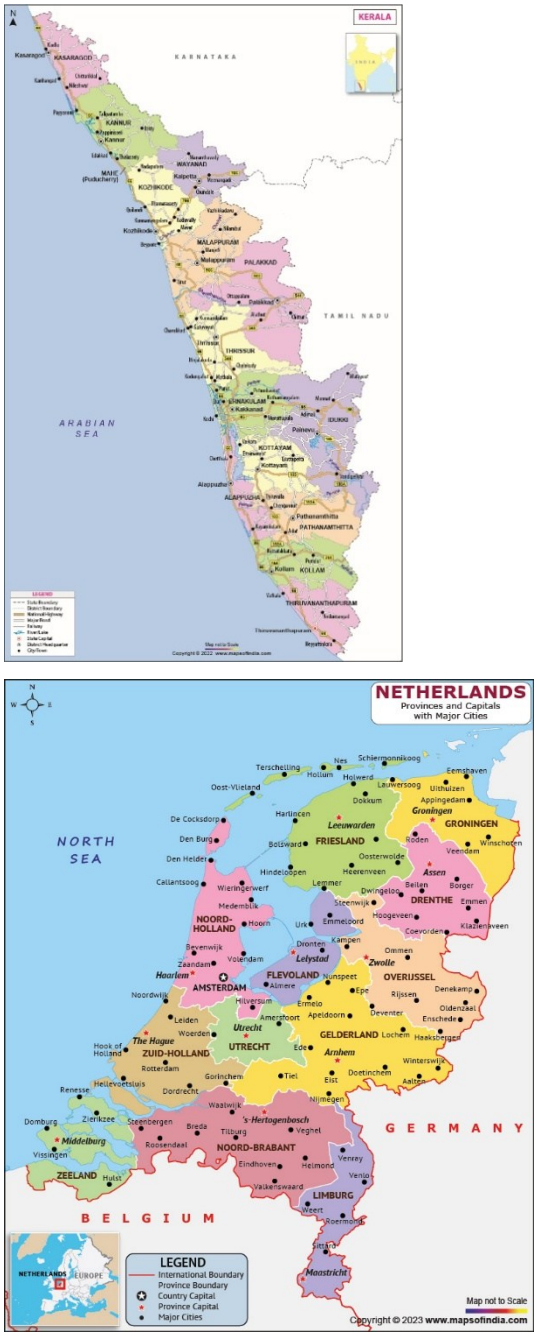

Figure1. Location of Kochi Municipal Corporation (Southern India) and The Netherlands

2. REVIEW OF LITERATURE

The existing literature limits itself to various coastal management strategies to combat climate induced inundation in a developed country. The rapid changing of the climate demands quicker adaptation responses, which are likely to be costly[76]. The adaptation strategies include scientific engineering without considering the local contexts. This review of literature examines the Netherlands renowned approach and its potential applicability to Kochi. The two local governments were chosen to analyse the plausibility of same strategies in different socio economic and demographic contexts. The IPCC[77] highlights the escalating threat of sea level rise to coastal communities and emphasises the differential impact on developing nations with vulnerable infrastructure, dense population and limited adaptive capacity[78]. The reports[79] establish that it could take more than 1000 years for the environmental measures like sea level and ocean surface temperature to return to pre industrial levels post-cessation of greenhouse emissions and demands moving beyond traditional mitigation strategies to encompass

[76] Adger, W.N. and Barnett, J., 2009. Four reasons for concern about adaptation to climate change. Environment and Planning A, 41(12), pp.2800-2805.

[77] IPCC, 2021: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, In press, doi:10.1017/9781009157896.

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robust adaptation measures[80]. The report on disasters by the World Bank and United Nations (2010)[81] highlights that about a fifth of the total humanitarian aid was devoted to post disaster relief and response[82].

Van Koningsveld et al., 2008 reports that the Netherlands, a low-lying European country with more than a quarter of its land below sea level has developed a sophisticated and integrated coastal management system[83]. The effectiveness of the "Room for River" Programme[84] and Delta Programme[85] encompassing dike reinforcement, sand nourishment and ecosystem-based solutions has been established in various reports[86]. Kochi registered the highest rising trend of 1.8 mm/year[87] in India has an *ad hoc* approach towards sea level rising[88], characterized by limited inter-agency

[80] W. Neil Adger, Nigel W. Arnell, Emma L. Tompkins, Successful adaptation to climate change across scales,
Global Environmental Change, Volume 15, Issue 2, 2005, Pages 77-86, ISSN 0959-3780, https://doi.org/10.1016/j.gloenvcha.2004.12.005.

[81] Nations, U., 2010. Natural hazards, unnatural disasters: the economics of effective prevention. The World Bank Group.

[82] Hanson, S., Nicholls, R., Ranger, N. et al. A global ranking of port cities with high exposure to climate extremes. Climatic Change 104, 89–111 (2011). https://doi.org/10.1007/s10584-010-9977-4 .

[83] van Koningsveld, Mark & Mulder, JPM & Mjf, Mjf & VanDervalk, L & VanDerWeck, AW. (2008). Living with Sea-Level Rise and Climate Change: A Case Study of the Netherlands. JOURNAL OF COASTAL RESEARCH. 24. 367-+. 10.2112/07A-0010.1.

[84] Rijke, J. et al. (2012) 'Room for the River: delivering integrated river basin management in the Netherlands', International Journal of River Basin Management, 10(4), pp. 369–382. doi: 10.1080/15715124.2012.739173.

[85] Deltares. (2014). *Delta Programme 2015*. Deltares.

[86] Klijn, F. *et al.* (2013) 'Design quality of room-for-the-river measures in the Netherlands: role and assessment of the quality team (Q-team)', *International Journal of River Basin Management*, 11(3), pp. 287–299. doi: 10.1080/15715124.2013.811418.

[87] Unnikrishnan, A.S., Nidheesh, A.G. and Lengaigne, M., 2015. Sea-level-rise trends off the Indian coasts during the last two decades. Current Science, pp.966-971.

[88] K., S., K.V., A. and V., A. (2023) 'Coastal vulnerability assessment along the coast of Kerala, India, based on physical, geological, and socio-economic parameters', *Marine Geodesy*, 47(2), pp. 119–149. doi: 10.1080/01490419.2023.2285944.

coordination and a lack of long-term planning[89] and lacks a holistic approach, failing to integrate scientific, social, and economic dimensions of sea level rise[90]. It highlights the need for interdisciplinary curricula that bridge the gap between legal and non-legal domains.

A critical question addressed in the literature is the transferability of Dutch coastal management strategies to the context of Kochi. Studies examining this aspect emphasize the need for adaptation to local socio-economic, environmental, and institutional conditions[91]. Research discusses the challenges of transferring governance models across different cultural and political contexts[92]. Works by Aggarwal et al. (2010)[93] analyse the role of local knowledge and community participation in adaptation planning, highlighting the potential for integrating traditional practices with modern engineering solutions.

[89] K, Sowmya & John, C.M. & Shrivasthava, N.K.. (2014). Urban flood vulnerability zoning of Cochin City, Southwest coast of India, using remote sensing and GIS. Natural Hazards. 75. 10.1007/s11069-014-1372-4.

[90] Annan-Diab, Fatima & Molinari, Carolina. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the Sustainable Development Goals. The International Journal of Management Education. 15. 10.1016/j.ijme.2017.03.006.

[91] J. Joyson Joe Jeevamani & P. Priya & J. Amali Infantina & K. R. Abhilash & Durga Prasad Behera & V. Deepak Samuel & R. Soundararajan & R. Purvaja & R. Ramesh, 2021. "An integrated approach to assess coastal vulnerability versus fisheries livelihood sustainability: Strategies for climate change adaptation in Sindhudurg, west coast of India," Environment, Development and Sustainability: A Multidisciplinary Approach to the Theory and Practice of Sustainable Development, Springer, vol. 23(3), pages 4011-4042, March.

[92] Blankesteijn, Marie & Pot, Wieke. (2024). Water Governance in the Netherlands. 10.1093/acrefore/9780199389414.013.863; Warner, Jeroen. (2005). Multi-stakeholder platforms: integrating society in water resource management? Ambiente & Sociedade 8 (2005) 2. 8. 10.1590/S1414-753X2005000200001.

[93] Agrawal, A. and Agrawal, A., 2008. The role of local institutions in adaptation to climate change (Vol. 17, p. 28274). Washington, DC: World Bank.

The efficacy of coastal adaptation strategies hinges on robust legal and policy frameworks. Comparative analyses of coastal management legislation in the Netherlands and India reveal significant differences in institutional capacity and enforcement mechanisms[94]. Works by Rajamani (2016)[95] explore the challenges of implementing international climate change agreements at the national and sub-national levels in India. Research also examines the role of judicial interventions in promoting coastal protection[96]. This paper evaluates the effectiveness of existing international, regional, and national legal- policy frameworks in addressing the rising sea levels and analyses the plausibility of global models adopted by the Netherlands in the local context of Kochi.

3. DUTCH COASTAL MANAGEMENT STRATEGIES

The Netherlands, a nation fundamentally shaped by its relationship with water, serves as a compelling case study for integrated coastal management and its implications for climate education, particularly concerning the impacts of inundation[97].[98].

[94] Klein, R.J., Eriksen, S.E., Næss, L.O., Hammill, A., Tanner, T.M., Robledo, C. and O'brien, K.L., 2007. Portfolio screening to support the mainstreaming of adaptation to climate change into development assistance. Climatic change, 84(1), pp.23-44.

[95] Rajamani, Lavanya. "The 2015 Paris Agreement: Interplay Between Hard, Soft and Non-Obligations." *Journal of Environmental Law* 28, no. 2 (2016): 337–58. https://www.jstor.org/stable/26168923.

[96] Cullet, P., 2013. Right to water in India–plugging conceptual and practical gaps. The International Journal of Human Rights, 17(1), pp.56-78.

[97] van Koningsveld, Mark & Mulder, JPM & Mjf, Mjf & VanDervalk, L & VanDerWeck, AW. (2008). Living with Sea-Level Rise and Climate Change: A Case Study of the Netherlands. JOURNAL OF COASTAL RESEARCH. 24. 367-+. 10.2112/07A-0010.1.

[98] Rijke, Jeroen & Herk, Sebastiaan & Zevenbergen, Chris & Ashley, Richard. (2012). Room for the River: Delivering integrated river basin management in the Netherlands. International Journal of River Basin Management. 10. 369-382. 10.1080/15715124.2012.739173.

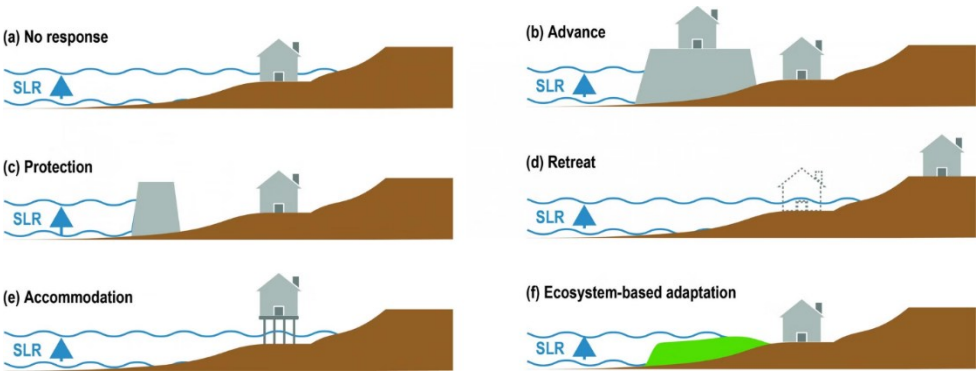

Figure 2 IPCC's Responses to Sea Level Rise

A nation largely situated below sea level, has cultivated world-renowned expertise in water management, driven by centuries of experience in coexisting with water. Its approach to coastal management has evolved significantly, encompassing both monumental engineering feats and innovative nature-based solutions, underpinned by robust institutional and financial frameworks and a commitment to public participation.

The genesis of the modern Dutch flood protection strategy lies in the devastating North Sea flood of 1953. This catastrophic event served as a catalyst for the establishment of the Delta Works Commission, which pioneered a comprehensive flood protection strategy. Central to this strategy was the development of the "Delta Norm," a conceptual framework for investment in flood defenses. This norm systematically identifies major "dike ring areas" requiring protection, quantifies the cost of potential flooding using a statistical model that includes damage to property, lost production, and a monetary valuation of human life (e.g., €2.2 million in 2008 data), and calculates flood probabilities based on empirical data and purpose-built flood simulation laboratories.

The acceptable risks defined by the Delta Norm were legally enshrined in the Delta Law, now incorporated into the Water Law, effective since December 22, 2009. This legal mandate requires the government to maintain flood risks within specified limits—for instance, 1 per 10,000 years for North and South Holland, 1 per 4,000 years for other sea-risk areas, and 1 per 2,000 years for transition areas—and critically, to upgrade defenses as new insights into risks emerge. [99] This legal codification of risk and the requirement for continuous adaptation represent a profound shift from reactive measures to an institutionalized, dynamic risk management system. It signifies that adaptation is not a one-time project but an ongoing, legally enforced process, ensuring sustained effort regardless of political cycles.

A prime example of this engineering prowess is the Maeslant Barrier, located near Hoek van Holland. This monumental engineering achievement, built between 1991 and 1997, is a vital component of the Delta Works[100]. and is globally recognized for having the largest moving parts among flood barriers. Designed to withstand storm surges of 5 meters above NAP (the average sea level in the North Sea), it protects approximately one million people in South Holland. The barrier comprises two enormous gates, each 210 meters wide, 22 meters high, and 15 meters deep. These gates function as hollow pontoons that float when open and are stowed in dry docks on either side of the waterway. When activated, they fill with river water and sink to the bottom within two hours, forming a near-hermetic block with a small 80-centimeter gap to prevent damage.

[99] Slomp, R.M., de Waal, J.P., Ruijgh, E.F.W., Kroon, T. and van Alphen, J.S.L.J., 2014, September. The Dutch Delta Model for policy analysis on flood risk management in The Netherlands. In *6th International Conference on Flood Management (ICFM6)*.
[100] Deltares. (2014). *Delta Programme 2015*. Deltares.

The operation of the Maeslant Barrier is fully automatic, triggered when water levels are predicted to exceed 3 meters above NAP near Rotterdam or 2.9 meters near Dordrecht. It employs a double-redundant computer system for exceptional reliability, with an operational team from Rijkswaterstaat always on hand for monitoring and manual intervention if necessary. Rijkswaterstaat, the Directorate-General for Public Works and Water Management, manages and maintains the barrier, conducting regular testing, inspections, and repairs based on sophisticated risk calculations. The construction of the barrier involved significant engineering challenges, including the creation of the world's largest ball-and-socket joints, each 10 meters in diameter and weighing 680 tons, specifically designed for this structure. The development of the Maeslant Barrier was not merely a technical feat; its design process involved close consultation with Rijkswaterstaat, the municipality of Rotterdam, and the water authority, considering factors such as cost, construction time, economic impact, and aesthetic integration into the landscape. This demonstrates that such massive engineering projects are deeply integrated into societal and economic planning, reflecting a collective commitment to protecting human life and economic activity, thereby representing a robust societal contract around flood safety.

While engineering marvels like the Delta Works provided robust protection, the severe floods of 1993 and 1995, which caused over EUR 400 million in damages and necessitated the evacuation of 250,000 people and a million animals, prompted a significant policy re-evaluation in the Netherlands. Previously, the country primarily relied on the construction of dykes and berms for flood mitigation. However, these events led to a major shift towards the adoption of nature-based solutions (NBS) for flood risk

management. [101] This new approach, encapsulated in the "Room for the River" program, focuses on creating sufficient space for rivers to flow naturally, rather than attempting to control them through ever-higher dams and dykes, thereby allowing cities to adapt sustainably to climate change. This represents a fundamental philosophical shift from an anthropocentric "control" paradigm to one of "coexistence" with natural processes, acknowledging that absolute control is often unsustainable and can lead to greater disaster.

The "Room for the River" program, and its subsequent extension, Room for the River 2.0, aims to restore landscapes along rivers through a variety of methods to safely absorb greater volumes of water. Key interventions include: floodplain excavation, depoldering, relocating dykes (moving them backward instead of raising them), lowering breakwater spurs or groynes, strengthening dykes (typically as a last resort), excavating riverbeds, removing obstacles, creating high water channels, and adding water storage. These projects involve a strategic mix of green and grey infrastructure, designed to enhance five key river functions: water discharge, navigability, freshwater availability and drinking water supply, nature and ecological water quality, and spatial economic development and spatial quality. [102].

The multi-functional benefits of this approach extend beyond mere flood protection, making catchment areas safer and more attractive, and generating opportunities for improved urban and rural development and

[101] Minkman, E. and van Buuren, A., 2019. Branding in policy translation: How the Dutch Delta approach became an international brand. *Environmental Science & Policy*, *96*, pp.114-122.

[102] van Koningsveld, Mark & Mulder, JPM & Mjf, Mjf & VanDervalk, L & VanDerWeck, AW. (2008). Living with Sea-Level Rise and Climate Change: A Case Study of the Netherlands. Journal Of Coastal Research. 24. 367-+. 10.2112/07A-0010.1.

recreational areas. For instance, in the city of Nijmegen, the creation of a secondary channel for the river Waal resulted in an island with significant natural, water, and recreational value, alongside a redeveloped waterfront. The program was entirely funded by the Dutch government, with a substantial budget of EUR 2.3 billion, not including ongoing maintenance costs. It involved extensive multi-ministerial collaboration (e.g., former Ministry of Transport and Water Management, Ministry of Agriculture, Ministry of Spatial Planning) and multi-level governance, with active participation from provinces, municipalities, water authorities, and Rijkswaterstaat. This demonstrates a strategic approach to infrastructure investment where projects are designed to deliver multiple socio-environmental and economic benefits, transforming flood mitigation into an opportunity for integrated regional development.

Dutch water governance is characterized by a robust, multi-level, publicly financed, and relatively decentralized system. Responsibilities for water management are shared comprehensively among the national government, the Directorate-General for Public Works and Water Management (Rijkswaterstaat), provinces, regional water authorities, and municipalities. Rijkswaterstaat, for example, is responsible for the management and maintenance of critical infrastructure like the Maeslant Barrier. Inter-ministerial and multi-stakeholder collaboration is foundational to this system, as exemplified by the "Room for the River" program, which involved multiple ministries, all levels of government, and the private sector.

The Delta Project, encompassing both the Delta Works and the "Room for the River" initiatives, is primarily financed through the dedicated Delta

Fund. This fund was initially estimated at 3.3 billion guilders (equivalent to 20% of national GDP at the time), spread over 25 years, with significant contributions from the Marshall Plan and natural gas discoveries. Currently, the Delta Fund is projected to have €27.4 billion available until 2050 for the Delta Programme, although the estimated need is €30.8 billion, indicating increasing costs associated with climate adaptation. This highlights the importance of establishing a dedicated, stable, and transparent financial mechanism for climate adaptation, as relying solely on general government budgets can lead to underfunding or project delays due to competing priorities.

A significant and continuous funding mechanism that underpins Dutch water management is the system of water authority taxes, which every resident in the Netherlands pays. These taxes include a water system charge (calculated based on property value or as a fixed amount per household) and a water treatment/pollution charge. These earmarked funds directly support the management of the water cycle, including the construction and maintenance of dikes, pumping stations, and wastewater treatment facilities, to prevent flooding and ensure clean water. This system fosters collective ownership and financial sustainability for long-term water safety, demonstrating that a robust financial framework is as critical as engineering prowess for successful long-term adaptation. [103].

Further reinforcing this institutional framework is the statutory role of the Delta Programme Commissioner. This position, legally anchored in the Delta Act of 2012, is responsible for submitting proposals for the national

[103] Bloemen, P., Van Der Steen, M. and Van Der Wal, Z., 2019. Designing a century ahead: Climate change adaptation in the Dutch Delta. *Policy and Society*, *38*(1), pp.58-76.

Delta Programme, including its financial implications. The Commissioner advises Cabinet members, monitors the progress of implementation, and actively garners public support for the Delta Programme, promoting consultation across administrative bodies, companies, and non-governmental organizations. While the coordinating minister (Minister of Infrastructure and Water Management) retains final political responsibility, the Commissioner's role ensures strategic oversight, coherence, and accountability across diverse actors, transcending ministerial silos. [104]. The Netherlands also actively promotes its water expertise globally through "water diplomacy," trade missions, and diplomatic networks, collaborating with other ministries, companies, and knowledge organizations to help countries implement preventive measures against flood s and droughts.[105]

Dutch water governance has a long history, but its evolution emphasizes robustness, adaptation, coordination, integration, and democratization as key ingredients for climate resilience. There is an ongoing exploration of deliberative forms of democracy and novel approaches to safeguard the interests of future generations. A prime example of successful public engagement is the "Room for the River" program. Despite initial resistance from farmers due to the necessity of acquiring agricultural land for floodplain creation, the program successfully gained support through the active participation of municipalities and local citizens in the decision-making process. Local communities were empowered to choose between

[104] Zevenbergen, C., Khan, S.A., van Alphen, J., Terwisscha van Scheltinga, C. and Veerbeek, W., 2018. Adaptive delta management: a comparison between the Netherlands and Bangladesh Delta Program. *International Journal of River Basin Management*, *16*(3), pp.299-305.

[105] KLIJN, F., QUALITY TEAM (Q-TEAM) ENSURES DESIGN QUALITY OF ROOM-FOR-THE-RIVER MEASURES IN THE NETHERLANDS.

alternative plans, provided these met the overarching program targets, which significantly helped to build and spread support at the municipal level. This demonstrates that meaningful public participation, where communities have agency and a voice in shaping solutions, is crucial for the successful implementation of large-scale adaptation projects, transforming potential opposition into local ownership. [106]

Citizen engagement is increasingly recognized as critical in the water sector, with citizens evolving from passive users to critical consumers and vocal participants. This necessitates a deliberate connection between technological solutions and social-governance issues. Water utilities, water authorities, municipalities, and regions are experiencing a growing interest in public engagement, requiring increased transparency and effective service provision. Citizen science and public participation are considered effective means for co-creating knowledge and innovation, and for understanding the diverse attitudes and behaviors of citizens regarding water. This signifies an evolution in governance philosophy where water management is no longer solely the domain of technical experts or centralized authorities. Instead, it is becoming a shared responsibility, requiring active collaboration between government, knowledge institutions, the private sector, community organizations, and citizens. This shift enhances transparency, accountability, and the legitimacy of adaptation measures, making them more robust and resilient in the long term. [107]

[106] Ward, Philip & Pauw, Willem Pieter & Van Buuren, Arwin & Marfai, Muh Aris. (2013). Governance of flood risk management in a time of climate change: The cases of Jakarta and Rotterdam. Environmental Politics. 22. 518-536. 10.1080/09644016.2012.683155.
[107] van Buuren, A., 2019. The dutch delta approach. *Great policy successes*, pp.201-217.

Figure 3

Figure 4

4. KOCHI'S CONTEXT AND CHALLENGES FOR ADAPTATION

The successful implementation of climate change adaptation strategies hinges critically on a granular understanding of the specific geographical, socio-economic, and institutional context of the affected region. Kochi, a vibrant urban agglomeration on India's southwest coast, presents a complex case study characterized by inherent environmental vulnerabilities and burgeoning development pressures.

Kochi (9° 58' N, 76° 14'E) ,the largest city along India's west coast after Mumbai, is geographically defined by its intricate estuarine environment. [108]. The city comprises a distinctive physiography of numerous low-lying islands, peninsulas, and sections of the mainland, all intricately interconnected by a vast network of water bodies, canals, rivers, and a significant international harbour.[109] Central to its identity is its proximity to the Arabian Sea and its extensive backwaters, forming part of the larger Vembanad Lake system. The constant tidal exchange with seawater through the northern end of the Cochin Backwaters, where the Periyar River opens to the Arabian Sea, imparts the characteristics of a typical estuary. [110].

[108] K., S., K.V., A., & V., A. (2023). Coastal vulnerability assessment along the coast of Kerala, India, based on physical, geological, and socio-economic parameters. *Marine Geodesy*, *47*(2), 119–149. https://doi.org/10.1080/01490419.2023.2285944.

[109] K., S., K.V., A., & V., A. (2023). Coastal vulnerability assessment along the coast of Kerala, India, based on physical, geological, and socio-economic parameters. *Marine Geodesy*, *47*(2), 119–149. https://doi.org/10.1080/01490419.2023.2285944.

[110] Mathew, S., 2012. Decision-making Methods for Local Government Adaptation to Future Climate Extremes: Evaluated in Kochi, India and Ku-ring-gai, Australia (Doctoral dissertation, Macquarie University, Faculty of Science, Department of Environment and Geography).

The coastal landforms of Kochi are composed of dynamic elements such as sand bars, barriers, sandy flats, and mud flats. The nearshore zones are notably shallow, often reaching a water depth of less than 5 meters within approximately 2 kilometres from the shore. This low and gently seaward-sloping coastal plain implies that even a marginal increase in sea level could precipitate a significant horizontal displacement of the coastline. [111]

Socio-economically, the region is characterized by a high population density. The urban agglomeration of Kochi experienced substantial growth, with its population increasing from 8.24 lakhs in 1981 to 21.17 lakhs by 2011. [112] This demographic expansion places immense pressure on coastal resources and infrastructure. The city's economic vitality is heavily reliant on its coastal activities, including the pivotal Port of Kochi, a thriving fishing industry, a burgeoning tourism sector, and a rapidly expanding Information Technology (IT) industry. These critical economic drivers are directly exposed to the impacts of a changing climate, underscoring the imperative for robust adaptation strategies. [113]

Even prior to the exacerbated effects of accelerated sea level rise, Kochi grapples with a range of acute coastal issues that underscore its inherent environmental fragility. The city experiences recurrent monsoon flooding

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[111] K Sowmya, CM John and NK Shrivasthava, 'Urban Flood Vulnerability Zoning of Cochin City, Southwest Coast of India, Using Remote Sensing and GIS' (2014) 75 *Natural Hazards* https://doi.org/10.1007/s11069-014-1372-4.

[112] Naidu, S.A., Rao, G.D., Vardhan, K.V., Kumaraswami, M., Rao, V.R. and Ramu, K., 2018. Impact of natural and anthropogenic disturbances on the benthic ecological quality of the coastal waters of Kochi, southwest coast of India. *International Journal of Environmental Research*, *12*, pp.861-875.

[113] Girish, Karthik. (2020). Coastal Erosion in Kerala.

and persistent urban drainage issues, largely attributed to inadequate infrastructure and the historical encroachment upon natural waterways. [114] Coastal erosion constitutes another significant challenge, with identifiable hotspots along its exposed shoreline resulting in land loss and damage to coastal properties and ecosystems.

A pervasive environmental concern is saltwater intrusion into groundwater aquifers, which has adverse implications for freshwater security for both domestic consumption and agricultural practices, particularly impacting agricultural lands and vegetation zones. [115] Furthermore, persistent waste management challenges continue to degrade the quality of the city's extensive network of water bodies and canals, compromising their ecological integrity and exacerbating flood risks. The prevalence of unplanned development in vulnerable coastal and backwater areas, often without adequate environmental assessments or adherence to zoning regulations, further compounds the city's exposure to climate hazards. While specific data on land subsidence in Kochi from the provided text is not explicit, it is recognized globally as a factor that can significantly compound the effects of sea level rise by effectively increasing relative sea level. For a low-lying, deltaic region like Kochi, this remains a critical factor warranting thorough investigation as it would intensify existing vulnerabilities.

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[114] S.A., Naidu & Rao, G.D. & Kanuri, Vishnu Vardhan & Munnooru, Kumaraswami & Rao, Vinjamuri & Ramu, Karri. (2018). Impact of Natural and Anthropogenic Disturbances on the Benthic Ecological Quality of the Coastal Waters of Kochi, Southwest Coast of India. International Journal of Environmental Research. 12. 10.1007/s41742-018-0140-9.

[115] K Sowmya, CM John and NK Shrivasthava, 'Urban Flood Vulnerability Zoning of Cochin City, Southwest Coast of India, Using Remote Sensing and GIS' (2014) 75 *Natural Hazards* https://doi.org/10.1007/s11069-014-1372-4.

In response to its coastal vulnerabilities, Kochi, within the broader frameworks established by Kerala and the Indian Union, has undertaken certain initiatives related to coastal protection and disaster management. These include the implementation and enforcement of Coastal Regulation Zone (CRZ) Notifications, designed to regulate development activities in coastal areas, and various disaster management plans aimed at preparedness and response to meteorological hazards.

However, the existing adaptation efforts frequently exhibit significant gaps and limitations concerning long-term sea level rise. They are often characterized by a reactive rather than a proactive approach, primarily focusing on immediate disaster response or the deployment of conventional, hard engineering solutions such as seawalls. The lack of an integrated, holistic strategy is evident in the fragmented responsibilities across various governmental departments and agencies, leading to uncoordinated interventions. While there might be sporadic efforts in mangrove conservation or sustainable fisheries, these often lack the scale, long-term vision, and cross-sectoral integration required for comprehensive SLR adaptation. The literature indicates a pressing need to move beyond these piecemeal approaches towards "improved versions of integrated coastal zone management projects" that actively involve government, non-governmental organizations, the public, and industries (Murali & Kumar, 2015). This recognized imperative underscores the current limitations in foresight, interdisciplinary collaboration, and community-centric planning, which are crucial for building enduring resilience against the escalating threat of sea level rise.

5. CONCLUSION & RECOMMENDATIONS

This paper has argued that effective climate change education, particularly in vulnerable coastal regions like Kochi, requires a fundamental integration of disciplines within educational curricula. The escalating challenges posed by sea-level rise (SLR) demand a holistic approach, combining legal, scientific, social, and economic perspectives. Traditional disciplinary silos are inadequate to address the complex, interconnected nature of climate change impacts.

The Dutch model, with its integrated coastal management strategies and robust institutional frameworks, provides a valuable case study for India. The Delta Programme's emphasis on both hard and soft engineering solutions, including the **wide green dike system**, and adaptive management demonstrates the potential for interdisciplinary collaboration. As highlighted by the "Wide Green Dikes" study, these systems offer several advantages, including lower initial costs, greater ease of repairs, increased adaptability, and enhanced spatial quality compared to traditional dike[116]. This approach is particularly relevant for climate-change adaptation due to its flexibility and integration with natural landscapes. However, transferring these strategies to India requires careful consideration of local socio-economic and environmental contexts, as well as the potential trade-offs regarding salt-marsh habitat.

Kochi's existing legal framework, while drawing upon national environmental laws, exhibits gaps in implementation and a tendency towards ad-hoc responses. The lack of specific adaptation plans and limited

[116] van Loon-Steensma, J.M. and Schelfhout, H.A., 2017. Wide Green Dikes: A sustainable adaptation option with benefits for both nature and landscape values?. *Land Use Policy*, *63*, pp.528-538.

local capacity highlight the need for a more proactive and integrated approach.

6. RECOMMENDATIONS

Tripartite Policy Making: Establish a **tripartite policy making** framework where **policymakers, experts, and victims** of climate change related issues are involved in the policy drafting and implementation process. This will ensure that the policies are based on scientific data, practical expertise, and the lived experiences of those most affected, especially regarding the implementation of adaptation measures like **wide green dikes**.

Evaluating Governance Models: Conducting comparative studies to examine the effectiveness of different governance models for coastal management in developing countries, including those that support the implementation of innovative solutions like **wide green dikes**.

Impact of Wide Green Dike Systems in Tropical Climates: Researching the application and effectiveness of wide green dike systems in tropical climates, and the legal implications of implementing such systems, including the trade-offs regarding salt-marsh habitat and ecological value.

By implementing these recommendations and pursuing these research opportunities, India can build a more climate-resilient future for its coastal communities, leveraging sustainable adaptation options like **wide green dikes** and fostering interdisciplinary climate education.

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V

THE ROLE OF INTERNATIONAL LEGAL FRAMEWORKS IN ADDRESSING CLIMATE CHANGE: CHALLENGES AND OPPORTUNITIES FOR GLOBAL COOPERATION

Dr. SHOBHA RANI. M*

ABSTRACT

Climate change remains one of the most critical global challenges of the 21st century, demanding coordinated international action and an interdisciplinary approach to education and governance. The rising global temperatures, extreme weather events, and sea-level rise disrupt environmental, economic, and social systems, highlighting the need for integrated responses that combine legal, scientific, economic, and ethical perspectives. This paper examines the role of international law in combating climate change, emphasizing how interdisciplinary learning can enhance understanding and implementation of global climate agreements.

The Paris Agreement serves as a cornerstone of international climate action, demonstrating the need for unified efforts to limit warming to well below 2°C, with aspirations for 1.5°C. However, its effectiveness is undermined by the voluntary nature of national commitments and the absence of robust enforcement mechanisms. Additionally, disparities between developed and developing nations regarding historical emissions and adaptive capacities complicate equitable climate governance. The

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principle of "common but differentiated responsibilities" (CBDR) and the ethical dimensions of climate justice must be integrated into interdisciplinary education to promote fairness and equity.

This paper highlights the potential for evolving international legal frameworks through robust compliance mechanisms, expanded climate litigation, and the integration of climate considerations into trade and finance. It argues that fostering stronger international solidarity, ensuring fair governance, and embedding human rights within climate law, supported by interdisciplinary educational approaches, are essential for enhancing global cooperation and addressing the urgent demands of the climate crisis.

Keywords: *Climate Change, International Law, Climate Justice, Paris Agreement, Climate Education*

1. INTRODUCTION

Climate change is a pressing reality affecting ecosystems, human communities, and economies worldwide. The rising global temperatures, extreme weather events, melting polar ice caps, and sea-level rise, pose serious threats that demand urgent, coordinated responses across borders. Addressing such a complex issue requires an interdisciplinary approach to climate change education, integrating environmental science, law, economics, and ethics to provide a comprehensive understanding of the crisis.

International legal frameworks, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, play

a vital role in guiding global mitigation and adaptation efforts. However, the effectiveness of these frameworks is often questioned due to the voluntary nature of commitments and lack of enforcement mechanisms. The disparity between developed and developing nations regarding historical emissions and adaptation resources further complicates equitable participation in climate action.

An interdisciplinary approach to climate change education is essential for understanding these complexities. Integrating legal, scientific, and socio-economic perspectives into curricula can prepare future leaders to navigate the intricacies of global climate governance. This paper critically examines international legal frameworks, their challenges, and opportunities for enhanced cooperation. It argues that interdisciplinary learning is crucial for fostering a generation capable of implementing equitable, effective climate solutions.

Key themes explored include the principle of "common but differentiated responsibilities" (CBDR), climate justice, climate litigation, and the integration of climate goals into trade and finance. It will explore the challenges these frameworks face, including the lack of binding enforcement mechanisms, the tensions between developed and developing nations, and the integration of climate justice principles into international law. At the same time, the paper will highlight opportunities for strengthening global cooperation, such as enhanced monitoring, the growing role of climate litigation, and the integration of climate goals into broader economic and trade policies.

2. LITERATURE REVIEW:

Existing research on climate change education highlights the importance of interdisciplinary approaches. Climate literacy requires knowledge of science, law, economics, and ethics. However, current academic frameworks often lack cohesive integration of these disciplines, limiting students' ability to grasp the multifaceted nature of climate issues.

Interdisciplinary learning promotes critical thinking and problem-solving skills essential for climate action. Research shows that students exposed to integrated curricula are better equipped to understand and address global challenges. However, significant gaps remain, particularly in linking legal frameworks with climate education.

Legal education often overlooks climate-related issues, while science-focused curricula may not address policy and governance aspects. This gap hampers comprehensive understanding and effective action. To address this, educational institutions must incorporate international legal principles, such as CBDR, and climate justice concepts into their programs.

Furthermore, climate justice literature underscores the disproportionate impacts of climate change on vulnerable populations. Integrating these perspectives into education fosters a deeper understanding of equity issues, preparing students to advocate for fair climate policies.

3. CORE ARGUMENT AND DISCUSSION:

The core argument of this paper is that interdisciplinary learning is essential for effective climate change education. Climate challenges transcend disciplinary boundaries, requiring knowledge of environmental science, international law, economics, and social justice. Integrating these areas into

curricula ensures that students develop the skills and knowledge needed to address complex climate issues.

Pedagogical approaches should include case-based learning, problem-solving exercises, and collaborative projects. For example, analyzing international agreements like the *Paris Agreement* and cases such as *Urgenda Foundation v. The State of Netherlands* can help students understand the intersection of law, science, and ethics.

3.1. The Role of International Legal Frameworks in Addressing Climate Change:

Climate change is an issue that affects the planet as a whole, with far-reaching consequences for ecosystems, economies, and human societies. Due to its transboundary nature, no single nation can address climate change independently; it requires coordinated action at the global level. International legal frameworks such as the *United Nations Framework Convention on Climate Change* (UNFCCC) and the *Paris Agreement* have been central in formalizing this cooperation, providing both a legal foundation and practical mechanisms for collective action.

3.1.1. The United Nations Framework Convention on Climate Change (UNFCCC)[117]

The **UNFCCC**, adopted in 1992, marked the first global treaty aimed at combating climate change. It set out a broad framework for future negotiations, encouraging countries to cooperate in reducing greenhouse gas

[117] United Nations Framework Convention on Climate Change, 'What is the United Nations Framework Convention on Climate Change' (https://unfccc.int/process-and-meetings/what-is-the-united-nations-framework-convention-on-climate-change), Accessed on 1 February 2025.

emissions, enhancing climate resilience, and sharing climate-related information and technologies. The UNFCCC itself is non-binding but establishes the principles for future legal agreements.

The key aspect of the UNFCCC is CBDR (Common but differentiated Responsibilities). This principle recognizes that all countries are responsible for addressing climate change, they have different capacities and historical contributions to global emissions. Developed countries, due to their historical emissions and greater resources, are expected to take the lead in combating climate change.

3.1.2. The Paris Agreement (2015)[118]

The *Paris Agreement*, adopted under the UNFCCC in 2015, represents a significant legal development in global climate governance. Unlike previous treaties, such as the Kyoto Protocol, the Paris Agreement introduced a more inclusive and flexible approach, with a primary goal of limiting global warming to below 2°C, preferably to 1.5°C, compared to pre-industrial levels. The agreement emphasizes voluntary, nationally determined contributions (NDCs) and a long-term goal of achieving a climate-neutral world by mid-century.

The key aspects of the Paris Agreement are NDC's (Voluntary Nationally Determined Contributions) and Adaptation and Financial Assistance.

- Countries submit their own climate action plans (NDCs), outlining their targets for emission reductions. Although these contributions are

[118] United Nations, 'The Paris Agreement' (https://www.un.org/en/climatechange/paris-agreement), Accessed on 1 February 2025.

not legally binding, countries are expected to report on their progress and update their commitments over time.

- The agreement also emphasizes support for developing countries, with developed nations committing to provide financial resources to help vulnerable countries mitigate and adapt to climate change impacts.

While the Paris Agreement itself is a major milestone in the fight against climate change, its voluntary nature (i.e., no legally binding enforcement mechanisms for countries that fail to meet their targets) raises concerns about its long-term effectiveness.

The international climate agreements provide a framework for cooperation and the legal precedents in International Climate Law, plays a significant role in shaping how these agreements are interpreted and enforced. Several cases have demonstrated how international courts and legal mechanisms can hold states accountable for failing to meet their climate obligations, thereby advancing climate justice.

One of the most influential cases in the context of climate change litigation was the *Urgenda Foundation v. The State of Netherlands*[119] *(Urgenda case)* in the Netherlands. The Urgenda Foundation, an environmental organization, filed a lawsuit against the Dutch government, claiming that its insufficient climate policies violated the European Convention on Human Rights (ECHR) and the UNFCCC obligations. The Dutch court ruled in favour of Urgenda, compelling the Dutch government to reduce its greenhouse gas emissions by at least 25% by 2020 compared to 1990 levels,

[119] [2015] Sabin Centre for Climate Change Law, https://climatecasechart.com/non-us-case/urgenda-foundation-v-kingdom-of-the-netherlands/, Accessed on 5 February 2025.

asserting that failing to take more ambitious action was a breach of the state's legal duty to protect the right to life and health under the ECHR.

The Legal Significance in this case was groundbreaking because, it was the first time a national court found a government's climate inaction to be in violation of human rights obligations. It set a precedent for how international environmental agreements can be linked to human rights, opening the door for further climate litigation.

In a significant legal development, in the case of *the Republic of the Philippines v. China*[120]**,** where the Philippines filed a case against China at the Permanent Court of Arbitration (PCA) over maritime disputes in the South China Sea. Although the case primarily focused on territorial disputes, the ruling also addressed environmental concerns related to the construction of artificial islands and the destruction of coral reefs. The court found that China had violated international environmental laws, including those under the *UN Convention on the Law of the Sea*[121] *(UNCLOS)*, which could be considered a broader legal framework relevant to climate change governance.

The Legal Significance in this case was that though it was not specifically a climate change case, this judgment is important because it demonstrates the growing recognition of environmental protection in international legal frameworks and highlights how international law can be used to hold states accountable for environmental degradation, which is directly tied to climate change impacts.

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[120] [2016] Permanent Court of Arbitration, 'Cases' https://pca-cpa.org/en/cases, Accessed on 9 February 2025.
[121] United Nations, 'Convention & Agreements', https://www.un.org/depts/los/convention_agreements, Accessed on 8 February 2025.

In *the People v. Shell and Other Fossil Fuel Companies,* several lawsuits have been filed by governments and activists targeting major fossil fuel companies, including Shell, ExxonMobil, and Chevron, holding them accountable for their contribution to global greenhouse gas emissions. In particular, a case filed in the Netherlands against Shell seeks to compel the company to align its policies with the Paris Agreement's goals, urging the court to set legally binding emission reduction targets for corporations.

The Legal Significance in this case is a part of an increasing trend of corporate accountability for climate change, demonstrating how climate litigation can extend beyond governments to hold private actors responsible for environmental harm. The outcomes of such cases could contribute to more robust international legal frameworks for regulating corporate emissions. The case is a step towards climate justice and reducing global emissions. It could lead to other fossil fuel companies being held accountable for their role in climate change.

Teaching methodologies must also emphasize experiential learning, allowing students to engage with real-world climate challenges. Partnerships with legal institutions, environmental organizations, and policymakers can provide practical insights and opportunities for applied learning. The inclusion of climate justice in curricula is particularly important. Students should explore how climate change affects marginalized communities and understand the legal frameworks addressing these inequities. Human rights-based approaches should be central to climate education, linking environmental protection with fundamental rights.

Moreover, interdisciplinary education should address the role of climate litigation. Landmark cases like *People v. Shell*[122] demonstrate how litigation can hold corporations accountable for emissions. Such cases highlight the legal significance of corporate responsibility and climate justice, reinforcing the need for robust international legal frameworks.

3.2. Challenges of Global Cooperation in Climate Change: Voluntary Pledges and Equity Concerns:

Global cooperation is vital to tackle climate change, yet it faces key challenges, particularly the voluntary nature of climate pledges and equity concerns. These issues undermine the effectiveness of international agreements like the Paris Agreement.

3.2.1. Voluntary Nature of Climate Pledges:

The Paris Agreement relies on voluntary Nationally Determined Contributions (NDCs), encouraging broad participation but lacking enforceability. The key challenges include:

- **Lack of Binding Commitments:** Unlike the Kyoto Protocol, the Paris Agreement does not impose legally binding emission targets, making enforcement difficult.
- **Insufficient Ambition:** Many NDCs fall short of the target to limit global warming to 1.5°C–2°C, creating a gap between pledged actions and actual climate needs.

[122] *Milieudefensie et al v Royal Dutch Shell plc* (District Court of The Hague, C/09/571932 / HA ZA 19-379, 26 May 2021), https://aida-americas.org, Accessed on 15 February 2025.

- **No Enforcement Mechanism:** Without legal obligations, compliance depends on international peer pressure, which often proves inadequate.

Example:

The U.S. Withdrawal from the Paris Agreement (2017–2021)[123] — In 2017, former U.S. President Donald Trump announced that the U.S. would withdraw from the Paris Agreement, arguing that the agreement disadvantaged the U.S. economically. Although President Joe Biden rejoined the agreement in 2021, the U.S. exit highlighted the risks of the voluntary nature of the Paris Agreement, as a major emitter could simply choose to walk away from the deal without facing significant legal repercussions.

3.2.2. Equity Concerns: Developed v. Developing Countries:

Equity is a central issue in climate negotiations, with disparities in historical responsibility, financial capacity, and climate vulnerability driving tensions.

- **Historical Responsibility:** Developed nations, having contributed most to historical emissions, are expected to lead climate action under the principle of Common but Differentiated Responsibilities (CBDR).
- **Financial & Technological Support:** Developing nations seek financial aid and technology transfer from developed countries to transition to low-carbon economies.

[123] White & Case, 'US Withdrawal from the Paris Agreement: Impact and Next Steps' https://www.whitecase.com/insight-alert/us-withdrawal-paris-agreement-impact-and-next-steps, Accessed on 12 February 2025.

- **Climate Justice:** Vulnerable communities in the Global South, despite minimal contributions to emissions, face the worst climate impacts and demand equitable climate policies.

Example:

India's Position on Equity — India has consistently emphasized the principle of equity in climate negotiations. As one of the largest and most populous developing nations, India argues that its responsibility for climate action should be differentiated from that of developed countries. India's position is based on its low per capita emissions and the need for development, which often requires increased emissions in the short term. India also stresses the need for financial support and technology transfer to enable climate adaptation and mitigation in the Global South. India's perspective is exemplified by its strong opposition to legally binding emission reduction targets for developing countries under the Kyoto Protocol and its insistence on the importance of climate finance in the Paris Agreement.

3.2.3. Legal Precedents on Climate Justice and Equity:

Legal cases in India and globally highlighted how climate justice and equity shape climate policies:

- **India's Supreme Court on Coal Mining[124] (2014):** In 2014, the Supreme Court of India declared the allocation of coal mining licenses to private companies since 1993 as illegal. While the case was not directly about climate change, it raised significant environmental concerns, including the impact of large-scale coal mining on carbon

[124] Manohar Lal Sharma v Principal Secretary & Others [2014] 9 SCC 516.

emissions and climate change. The ruling was an example of how the judiciary in India is addressing issues of environmental degradation, which is intrinsically linked to the climate crisis.

- **Public Interest Litigation (PIL) on Climate Change[125] (2017):** Activists urged the Indian government to integrate Paris Agreement goals into development policies, highlighting the judiciary's growing role in climate governance.
- ***Philippines v. China[126] (South China Sea Dispute):*** The Permanent Court of Arbitration ruled in favour of the Philippines, citing environmental damage. The case illustrates how climate-related environmental concerns intersect with international law and geopolitical issues

3.3. Climate Justice and the Role of Human Rights in Shaping International Climate Law:

Climate justice connects climate change with human rights, emphasizing fairness in distributing climate responsibilities and impacts. It highlights the moral and legal obligation to protect vulnerable populations, especially those least responsible for climate change but most affected by it. Human rights considerations—such as the rights to life, health, food, and a healthy environment—are increasingly shaping international climate law, ensuring that climate action aligns with the protection of these rights.

[125] Ridhima Pandey v Union of India [National Green Tribunal 2017].

[126] The South China Sea Arbitration (Philippines v China) (Award) [2016] PCA Case No 2013-19.

3.3.1. Human Rights and International Climate Law

Climate change threatens multiple human rights, making their protection central to climate governance:

- Right to Life: Extreme weather events, such as floods and droughts, pose direct risks to human life.
- Right to Health: Climate-related health issues include the spread of diseases, malnutrition, and heat stress.
- Right to Adequate Housing: Rising sea levels and disasters cause displacement, threatening housing security.
- Right to Food: Climate impacts on agriculture worsen food insecurity, especially in vulnerable regions.

Recognizing these rights drives international efforts to integrate human rights into climate policies, compelling states to adopt climate actions that safeguard these fundamental protections.

3.3.2. Legal Precedents at the Intersection of Climate Change and Human Rights

The several landmark cases have demonstrated the growing recognition of climate justice and human rights within the context of international climate law. These cases often focus on holding states and corporations accountable for their failure to prevent or mitigate climate impacts, based on their human rights obligations.

- ***Urgenda Foundation v. The State of Netherlands***[127] **(2015):**

The Dutch court ruled that the government's inadequate climate policies violated the *European Convention on Human Rights* (Articles 2 and 8, rights

[127] District Court of The Hague, C/09/456689 / HA ZA 13-1396, [24 June 2015].

to life and family life). The court ordered the Netherlands to cut emissions by at least 25% (from 1990 levels) by 2020, establishing a landmark precedent for holding governments accountable through human rights law.

- ***Shell Climate Case[128] (2021): Dutch Court***

A Dutch court ordered Royal Dutch Shell to reduce its emissions by 45% by 2030 (from 2019 levels), surpassing Shell's targets. The ruling held that Shell's operations violated the right to a healthy environment and demonstrated that corporations, not just governments, have human rights obligations in addressing climate change.

4. CASE STUDIES & BEST PRACTICES

Several global and national case studies demonstrate successful curriculum integration. For example, the University of Oslo's interdisciplinary climate studies program combines law, science, and economics, preparing students for roles in climate governance. Similarly, Yale University's Environmental Studies program incorporates policy and legal analysis, offering a comprehensive approach to climate education.

Institutional frameworks supporting these programs include dedicated climate research centers, interdisciplinary faculty collaborations, and partnerships with international organizations. These structures provide students with access to diverse expertise and practical learning opportunities.

However, challenges persist. Institutional resistance to curriculum changes, lack of resources, and limited faculty expertise in interdisciplinary teaching

[128] *Milieudefensie et al v Royal Dutch Shell plc* (District Court of The Hague, C/09/571932 / HA ZA 19-379), [26 May 2021].

hinder progress. Policymakers and educators must address these barriers by providing funding, professional development, and incentives for interdisciplinary collaboration.

Opportunities for advancement include developing standardized interdisciplinary curricula, promoting international exchanges, and incorporating climate considerations into broader educational policies. Emphasizing the role of climate litigation and corporate accountability in education can also enhance understanding of legal mechanisms driving climate action.

5. KEY FINDINGS:

i. The Importance of International Legal Frameworks:

- International agreements like the Paris Agreement serve as foundational instruments for global climate cooperation. However, the voluntary nature of pledges and lack of robust enforcement mechanisms remain significant challenges.
- The principle of common but differentiated responsibilities is crucial to recognizing the inequities between developed and developing nations, but its application remains contentious in negotiations and implementation.

ii. Challenges of Global Cooperation:

- Voluntary climate pledges and the absence of legally binding obligations in key agreements create uncertainty regarding global progress towards climate goals. This significantly undermines the overall effectiveness of international legal frameworks.

- The disparity between developed and developing countries, particularly regarding historical emissions and financial capacities, continues to fuel disagreements over the burden-sharing of climate action and financing.

iii. The Role of Climate Justice:

- **Climate justice**, grounded in human rights, is an increasingly important concept in shaping international climate law. The recognition of climate change's disproportionate impacts on vulnerable populations is shifting the legal discourse towards equity and fairness.
- **Human rights-based approaches** are now central to international climate litigation, with key rulings (such as *the Urgenda case* and the *Shell litigation*) emphasizing the connection between climate change and the right to life, health, and a safe environment.

iv. Opportunities to Strengthen International Legal Frameworks:

- **Enhanced compliance mechanisms**—including binding obligations, transparent reporting systems, and independent monitoring—are essential for ensuring that countries meet their climate goals and remain accountable to international agreements.
- **Climate litigation** has emerged as a vital tool in holding both states and corporations accountable for their actions, particularly as courts increasingly integrate human rights principles into their rulings. Cases like *Urgenda, Shell,* and *Leghari v. Pakistan* have set important precedents for holding governments and businesses to their climate commitments.

v. The Landmark Case Laws Highlighting the Role of Climate Litigation:

- *Leghari v. Federation of Pakistan (2015)*[129]*:* This case in Pakistan is a landmark example of climate litigation in the Global South. In this case, Raza Ali Leghari, a Pakistani citizen, filed a petition arguing that the government's failure to implement its own National Climate Change Policy violated his constitutional right to life and the right to a healthy environment. The Lahore High Court ruled in favour of Leghari, ordering the government to take immediate action to implement its climate change policy. This case underscores the potential for human rights-based litigation to push governments to take climate action, particularly in developing countries.

6. RECOMMENDATIONS & CONCLUSION:

As the world grapples with the escalating impacts of climate change, the need for enhanced international cooperation and stronger legal frameworks has never been more urgent. This research has highlighted several critical elements necessary to advance global climate cooperation, particularly through the strengthening of international legal frameworks, compliance mechanisms, and the growing role of climate litigation.

6.1. Recommendations for Advancing Global Climate Cooperation:

6.1.1. Strengthen Compliance Mechanisms in Climate Agreements:

- The Paris Agreement and similar frameworks should move toward binding legal obligations rather than relying solely on voluntary pledges. Introducing penalties or sanctions for non-

[129] Leghari v Federation of Pakistan [2015] WP No 25501/2015 (Lahore HC).

compliance would create stronger incentives for countries to fulfil their commitments.

- Expand the use of climate finance as a lever for compliance, linking access to financial resources for adaptation and mitigation to measurable climate action outcomes, especially for developing countries.

- While the Paris Agreement's voluntary approach fosters inclusivity, it lacks teeth in ensuring compliance. Future research and policy proposals should examine models from other international legal regimes. For instance, the World Trade Organization (WTO) employs a dispute settlement mechanism where non-compliance can result in trade sanctions. Similarly, international human rights law, via mechanisms like the UN Human Rights Committee, offers review processes and follow-up procedures. These models can inform the development of a compliance review body within the UNFCCC framework, which may issue recommendations or trigger peer-review mechanisms for underperforming nations.

- Further, the notion of "climate conditionality"—linking access to climate finance to demonstrable progress in emissions reductions—should be explored as a compliance incentive.

6.1.2. Expand the Role of Climate Litigation in Enforcing Climate Action:

- Support the expansion of legal standing for climate cases, allowing more individuals, organizations, and communities to challenge insufficient climate policies and hold governments and corporations accountable for their climate impact.

- Integrate human rights and environmental law more explicitly into climate litigation to bolster claims that inaction on climate change violates basic human rights, including the right to life, health, and a sustainable environment.
- Encourage the establishment of international legal precedents that enforce climate action through courts, including expanding opportunities for climate litigation at both the national and international levels, to hold governments and corporations accountable for their contributions to climate change.
- The discussion on climate litigation involving corporations should be expanded to include proactive roles of businesses in climate governance. The rise of Environmental, Social, and Governance (ESG) criteria has pushed many multinational corporations to adopt emission targets aligned with the Science-Based Targets initiative (SBTi). Legal frameworks could incorporate or mandate disclosure of climate-related financial risks under instruments like the Task Force on Climate-related Financial Disclosures (TCFD).
- Moreover, international investment law could require foreign investors to uphold environmental standards, creating a legal pathway for enforcing climate commitments within bilateral investment treaties (BITs). These strategies demonstrate that regulatory integration, not only litigation, is essential to corporate accountability.

6.1.3. Promote Climate Justice and Equity:

- Ensure that climate justice is at the heart of international negotiations, recognizing the disproportionate impacts of climate change on vulnerable and marginalized communities. This can be achieved by incorporating stronger equity measures in global climate agreements.
- Develop comprehensive adaptation strategies for countries most vulnerable to climate impacts, including specific support for indigenous communities, small island states, and low-income nations in the Global South.
- Indigenous peoples are custodians of biodiversity-rich regions and possess generations of climate-resilient knowledge. However, their contributions are often overlooked in international agreements. Incorporating Free, Prior, and Informed Consent (FPIC) standards from the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) into climate governance can ensure that indigenous voices are respected.
- Legal frameworks should recognize indigenous land rights, integrate traditional ecological knowledge into adaptation strategies, and protect indigenous communities from displacement due to climate mitigation projects (e.g., afforestation). A rights-based approach ensures both environmental justice and cultural preservation.

6.1.4. Improve Transparency and Accountability in Climate Action:

- Regular, independent monitoring of countries' emissions reductions, along with transparent reporting systems, will improve accountability and make it easier to track progress toward meeting international climate goals.
- Countries should be required to report on not just their greenhouse gas emissions, but also the effectiveness of their adaptation efforts, particularly in regions most affected by climate change.
- While global frameworks dominate discourse, regional agreements offer unique contributions. The European Union (EU) has adopted binding climate laws, such as the European Climate Law (2021), which mandates carbon neutrality by 2050 and includes enforcement mechanisms via the Court of Justice of the EU. In Africa, the African Union's Climate Change Strategy (2022–2032) promotes regional adaptation and resilience initiatives.
- Exploring such models can highlight how regional cooperation supplements global efforts, offering flexible responses tailored to geographical, cultural, and economic contexts.

6.1.5. Foster International Collaboration Beyond National Borders:

- Build stronger cross-border cooperation through shared technology, research, and innovation in climate solutions. This includes the transfer of clean energy technologies, capacity-building, and financial mechanisms for countries in need.

- Strengthen international partnerships that promote green finance, the development of renewable energy, and the integration of climate change considerations into trade agreements, international development projects, and financial markets.
- Non-state actors such as youth movements (e.g., Fridays for Future), cities (e.g., C40 Cities Climate Leadership Group), and civil society are increasingly influential in climate governance. Legal recognition of these actors can be expanded through observer status in treaty negotiations and participatory mechanisms in national implementation plans.
- Subnational governments often act as innovators. For example, California's cap-and-trade program and renewable energy mandates outpace federal standards. Legal frameworks should thus institutionalize multi-level governance, allowing local innovations to inform global strategies.

In the ongoing case of *Juliana v. United States*[130], the Youth plaintiffs allege that U.S. government's actions violated their constitutional rights by exacerbating climate change.

Though dismissed on procedural grounds, it expanded the conversation on youth standing, intergenerational equity, and non-state actor influence in climate law.

6.1.6. Emerging Legal Doctrines: Ecocide and Rights of Nature:

- There is growing momentum behind the recognition of "ecocide" as an international crime. A draft definition proposed by international

[130] 947 F.3d 1159 [9th Cir. 2020].

legal experts seeks to include ecocide under the Rome Statute of the International Criminal Court (ICC). Recognizing ecocide could deter large-scale environmental destruction and compel state and corporate actors to reconsider harmful practices.

- Additionally, the "Rights of Nature" movement seen in Bolivia, Ecuador, and some U.S. municipalities grants ecosystems legal standing. This paradigm shift redefines legal relationships with the environment, aligning law with ecological interdependence.

6.1.7. Evaluating Interdisciplinary Climate Education - Empirical Insights:

The author of the paper mainly focused on interdisciplinary education, which is critical. Hence, incorporating empirical evidence will strengthen this argument. For instance, studies from the University of Oslo and Yale University show that students in integrated climate programs demonstrate higher engagement with policy debates and are more likely to pursue climate-related careers.

Quantitative data on outcomes such as job placement in sustainability roles, performance in simulated negotiations, or policy formulation skills can demonstrate the effectiveness of interdisciplinary curricula and justify broader implementation.

A study titled *"Education for Sustainable Development - Empirical Evidence from Delhi University Students"*[131] indicates that students enrolled

[131] Shivangi Dhawan, 'Education for Sustainable Development: Empirical Evidence from Delhi University Students' (2022) 25(3) *Journal of Education, Rabindra Bharati University.*

in sustainability-focused programs exhibit heightened environmental awareness and are more inclined to engage in pro-environmental behaviours. Research on climate change education in Kerala's secondary schools and colleges highlights the integration of climate topics into curricula, leading to increased student participation in environmental activities and a deeper understanding of climate issues[132].

Indian universities are progressively embracing interdisciplinary climate education, with empirical studies indicating positive impacts on student engagement and career prospects.

6.1.8. Legal Implications of Climate-Related Technologies

Climate law must evolve alongside technological innovations. Tools such as satellite-based emissions monitoring, blockchain for carbon markets, and artificial intelligence in climate forecasting raise novel legal questions. Who owns climate data? Can emissions evidence be used in litigation?

International law must set standards for data transparency, privacy, and equity in tech-driven climate governance. Legal instruments should also ensure that digital climate solutions are accessible to developing countries to prevent widening the technology gap.

- In *ClientEarth v. UK Secretary of State for Business, Energy and Industrial Strategy*[133]

[132] Dailux Joseph, 'Climate Change Education Initiatives in Secondary Schools and Colleges in Kerala' (International Research and Publishing Journal, 15 October 2022) https://irpj.euclid.int/articles/climate-change-education-initiatives-in-secondary-schools-and-colleges-in-kerala, Accessed 22 May 2025.

[133] [2023] EWHC 2141 (Admin).

The legality of the UK's Net Zero Strategy based on scientific modelling was raised. The climate modelling was used as legal evidence to challenge policy sufficiency, illustrating the emerging role of climate tech in legal arguments.

6.1.9. Actionable recommendations for Universities and Institutions:

1. **Curriculum Integration**: Develop interdisciplinary programs combining law, science, and economics, with a focus on climate justice and human rights.
2. **Experiential Learning**: Establish partnerships with legal institutions, environmental organizations, and policymakers to provide practical learning opportunities.
3. **Faculty Development**: Offer training and incentives for faculty to engage in interdisciplinary teaching and research.
4. **Global Collaboration**: Promote international exchanges and partnerships to share best practices and enhance climate education.
5. **Policy Alignment**: Align educational policies with international climate goals, ensuring that curricula reflect evolving global priorities.

Future research should explore innovative pedagogical approaches, the impact of climate education on policy development, and strategies for overcoming institutional barriers. By fostering interdisciplinary climate education, institutions can equip students with the tools needed to address the climate crisis effectively and equitably.

6.2. Conclusion

The fight against climate change requires a robust, dynamic international legal framework, one that is capable of holding both governments and corporations accountable for their actions. Strengthening **compliance mechanisms** and expanding **climate litigation** are critical in achieving the urgent emissions reductions needed to limit global warming and mitigate the impacts of climate change. Additionally, a focus on **climate justice** ensures that those most vulnerable to climate impacts are not left behind and that equity is at the center of the global response.

Climate change remains one of the most critical and urgent challenges facing the global community. The need for robust, cooperative, and legally binding international frameworks is essential to effectively combat this crisis and mitigate its far-reaching impacts. While agreements like the Paris Agreement have laid the groundwork for global action, significant challenges remain, including the voluntary nature of national pledges, the lack of strong enforcement mechanisms, and the disparities between developed and developing nations in terms of responsibilities and capacities.

This paper concludes by stating that interdisciplinary climate change education is essential for preparing future leaders to navigate the complexities of global climate governance. Key arguments include the need for integrated curricula that combine legal, scientific, and socio-economic perspectives; the importance of climate justice and human rights in climate education; and the role of climate litigation in advancing accountability.

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VI

GREEN DEALS OR LEGAL BATTLES? NAVIGATING TRADE AND INVESTMENT DISPUTES IN THE CLIMATE ERA

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ABSTRACT

The legal environment at the intersection of trade, investment, and environmental law is becoming increasingly complex as international efforts to address climate change accelerate. Countries are enforcing strict environmental rules, green subsidies, and carbon levies to fulfil their pledges, but these actions often lead to conflicts between economic interests and environmental policy under investor-state dispute settlement (ISDS) procedures and World Trade Organisation (WTO) regulations. The EU Carbon Border Adjustment Mechanism (CBAM) and investor lawsuits against climate policies raise concerns about unfair trade advantages. The rise of regulations and the legal risks associated with greenwashing, carbon credit fraud, and sustainable finance compliance are also examined. The paper investigates whether current trade and investment legislation can balance economic stability with climate goals by examining recent case law,

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judicial interventions, and international treaty frameworks. It suggests a new legal architecture that strikes a balance between corporate responsibility, climate justice, and state regulatory sovereignty. Legislative reforms are suggested to reduce future conflicts and match international trade and investment policies alongside sustainable development goals. International accords like the Paris Agreement have a growing demand for governments to develop policies that maintain economic competitiveness while lowering carbon emissions. New dispute resolution procedures are required due to international trade organizations finding it difficult to balance trade liberalization with climate-based trade restrictions. Courts are increasingly interpreting trade agreements in ways that prioritize environmental sustainability, and investor-state arbitration is influencing climate rule controversies. The paper concludes that changing international legal frameworks is urgent to avoid legal disputes that might impede climate action and ensure long-term sustainability. Harmonizing trade, investment, and climate law is necessary for achieving long-term sustainability and upholding international climate obligations.

***Keywords**: climate law, trade and investment disputes, wto, isds, carbon border taxes, esg regulations, green finance, sustainable development.*

1. Introduction

The intersection between environmental legislation, commerce, and investment is become more complicated as global attempts to address climate change escalate. To fulfil their climate pledges, governments everywhere are enforcing strict environmental laws, encouraging green subsidies, and the imposition of carbon taxes. Although these steps are

essential for reducing environmental damage, they frequently lead to conflicts between economic interests and environmental regulations, especially when considering the Investor-State Dispute Settlement (ISDS) system and World Trade Organisation (WTO) regulations. Examples of how businesses are utilising ISDS to challenge government decisions to phase out high-emission sectors are RWE v. Netherlands[134] and Rockhopper v. Italy[135]. These disagreements bring up important legal issues on how to strike a balance between state authority to regulate for environmental sustainability and investor interests. WTO regulations also add another level of intricacy to the law. The WTO's core values of free trade and non-discrimination frequently conflict with new climate measures that limit imports according to their carbon footprint. The Carbon Border Adjustment Mechanism (CBAM) of the European Union, which levies taxes on imports from nations with laxer environmental laws, is a good illustration. Although the EU contends that CBAM is required to stop carbon leaks and encourage fair competition, a number of nations see it as a protectionist policy that goes against WTO rules. In establishing whether climate-based trade restrictions are permissible under international law, any legal challenges against CBAM might establish important precedents. Legal concerns have also been raised about green subsidies. Financial incentives are being provided by governments more frequently to encourage the use of electric vehicles, renewable energy, and other sustainable projects. Trade conflicts might arise, though, if such subsidies are thought to give unfair advantages to local sectors. For example, the US Inflation Reduction Act (IRA) of 2022, which

[134] RWE v. Netherlands, , ICSID Case No. ARB/21/4 (2021).
[135] Rockhopper v. Italy, , ICSID Case No. ARB/17/14 (2022).

provides large subsidies for investments in renewable energy, has caused friction with the EU and other trading partners, who claim it distorts competition. Careful legal interpretations of WTO regulations on subsidies and their relevance to climate policy are necessary to settle these conflicts. The function of Environmental, Social, and Governance (ESG) laws in international investment and commerce is another developing topic. Businesses must implement sustainable practices in order to comply with ESG standards, but doing so exposes them to legal concerns such as being accused of greenwashing and failing to disclose sustainability information. The need for more transparent legal frameworks to guarantee accountability and encourage sincere sustainability initiatives is highlighted by court cases involving ESG-related legislation, carbon credit fraud, and sustainable finance rules. With courts and arbitration tribunals playing a significant role in forming jurisprudence, the legal environment regulating trade and investment conflicts relating to climate change is constantly changing. Setting new precedents that put climate sustainability first, national and international courts are increasingly reading trade and investment agreements through an environmental lens. International law is changing in previously unheard-of ways due to disputes over emissions trading schemes, cross-border carbon pricing, and the validity of green trade policies. Reforms are urgently needed to guarantee that global economic policies are in line with climate goals, given the growing frequency and complexity of these legal challenges. A number of possible reforms could be taken into consideration, such as updating WTO regulations to include trade measures related to climate change, updating investment treaties to include environmental protections, and fortifying dispute resolution procedures to offer more precise direction on striking a balance between trade, investment,

and climate goals. In conclusion, there are possibilities and difficulties for attaining sustainable development at the nexus of trade, investment, and climate law. The critical need for a unified international legal framework that balances economic interests with environmental imperatives is highlighted by legal challenges resulting from climate legislation. To ensure that climate action is backed by a strong and flexible legal system rather than being hampered by drawn-out legal disputes, it will be imperative to address these issues through legal changes and international collaboration.

2. Review of literature

Numerous scholarly works have examined the relationship between commerce, investment, and environmental legislation. The legal issues raised by trade and investment conflicts relating to climate change have been studied by academics, especially in the context of the WTO and ISDS systems.

2.1. Education on Climate Change

A multidisciplinary approach is necessary to successfully address environmental concerns, according to existing research on climate change education. According to academics like Sterling (2016)[136], there are gaps in our knowledge of the legal, economic, and scientific aspects of climate change since traditional educational paradigms do not account for its complexity. Monroe et al.'s (2019)[137] research emphasises the value of policy-oriented curriculum and experiential learning in promoting a better

[136] S Sterling, 'A Commentary on Education and Sustainable Development' (2016) 17(2) *Environmental Education Research* 233.
[137] M C Monroe, R Plate, A Oxarart, A Bowers and M Chaves, 'Identifying Effective Climate Change Education Strategies: A Systematic Review of the Research' (2019) 20(3) *Environmental Education Research* 376.

understanding of climate legislation and policy. The importance of interdisciplinary education in resolving trade and investment conflicts connected to climate change is becoming more widely acknowledged. According to research by Barth et al. (2020)[138], in order to educate aspiring professionals for the difficulties of climate governance, legal education should incorporate environmental science and economic policy. In a similar vein, Tilbury (2011)[139] highlights the need of sustainability teaching in business and law schools and promotes faculty collaboration across disciplines to provide comprehensive solutions.

2.2. Deficits in Frameworks for Legal and Non-Legal Education

There are still a lot of holes in the legal and non-legal academic frameworks, notwithstanding the progress made in climate change education. Van Zanten and Van Tulder (2018)[140] claim that a lack of emphasis on climate-related dispute resolution procedures in legal school frequently leaves aspiring solicitors unprepared for new issues in trade and investment law. On the other hand, regulatory complexity is usually ignored in non-legal education in business and environmental sciences, resulting in a gap between policy implementation and compliance.

[138] M Barth, J Godemann, M Rieckmann and U Stoltenberg, 'Developing Key Competencies for Sustainable Development in Higher Education' (2020) 29(2) *International Journal of Sustainability in Higher Education* 146.
[139] D Tilbury, *Higher Education for Sustainability: A Global Overview of Commitment and Progress* (UNESCO 2011).
[140] J A van Zanten and R van Tulder, 'Multinational Enterprises and the Sustainable Development Goals: An Institutional Approach to Corporate Engagement' (2018) 25(3) *Journal of International Business Policy* 208.

2.3. Climate Change Policy and the WTO

The WTO's involvement in addressing trade policy connected to climate change has been one of the main topics of legal studies. The possible contradictions between environmental protection policies and trade liberalisation ideas have been studied. Pauwelyn (2013)[141] draws attention to the conflict between carbon border adjustment mechanisms and WTO non-discrimination principles, contending that although such measures are required to stop carbon leakage, they may also be contested as protectionist policies under WTO rules. Similarly, Howse (2015)[142] argues that the WTO has to change to adapt to trade policy connected to climate change without compromising the ideals of free trade.

2.4. Corporate Responsibility and ESG Laws

The necessity for legal clarity and the dangers of greenwashing have been emphasised in the literature on ESG legislation and sustainable financing. Zerk (2021)[143] looks at the legal responsibilities that firms have under ESG frameworks and talks about how courts are becoming more involved in upholding sustainability pledges. Stricter compliance requirements in international markets are shown by the changing legislative standards for corporate environmental responsibility. Furthermore, Norton (2022)[144]contends that multinational firms have compliance difficulties and

[141] J Pauwelyn, 'Carbon Leakage Measures and Border Tax Adjustments under WTO Law' (2013) 12(4) *World Trade Review* 621.
[142] R Howse, 'WTO Governance and Climate Change: The Need for Policy Space in the Trade Regime' (2015) 56 *Harvard International Law Journal* 435.
[143] J A Zerk, 'Corporate Sustainability Due Diligence: The Role of the Law' (2021) *British Institute of International and Comparative Law Report.*
[144] T Norton, 'The Global Rise of ESG Regulation: Navigating the Legal Landscape for Sustainable Finance' (2022) *Journal of Environmental Law and Policy* 24.

potential legal discrepancies as a result of the absence of worldwide standardisation in ESG frameworks.

2.5. The Function of Arbitration and International Courts

The influence of international courts and tribunals on the development of trade and investment jurisprudence pertaining to climate change has also been the subject of recent research. According to Kriebaum (2022)[145], there is a shift in legal precedent as court interpretations of trade and investment agreements place a greater emphasis on environmental issues. According to the expanding corpus of case law, courts are essential in determining how to strike a balance between economic interests and environmental sustainability. Furthermore, arcia (2023)[146] emphasises how new approaches to climate litigation are developing and impacting both national and international legal frameworks.

Once everything is taken into account the literature emphasises the necessity of a cogent international legal framework that harmonises investment and trade policies with climate objectives. In order to avoid disputes that can impede climate action, academics support changes to the current legal framework. The international community may more effectively address environmental issues while preserving economic stability by combining climate education, multidisciplinary learning, and legislative reforms.

[145] U Kriebaum, 'Environmental Protection and Investment Arbitration: Troubling Trends or Sustainable Developments?' (2022) 23 *Journal of World Investment & Trade* 15.
[146] José Ángel Rueda García, 'Climate Change and International Investment Law: What Are the Challenges and Uncertainties?' (EFILA Annual Conference, 16 March 2023).

3. Balancing Trade, Investment, and Climate Action: Legal Challenges and Emerging Jurisprudence

The legal environment pertaining to trade and investment disputes including climate change is changing quickly. The conflict between environmental rules and trade policy is exemplified by a number of significant incidents. Conflicts over trade barriers, investor rights, and environmental exclusions emerge as governments enact climate measures. International legal frameworks and the degree to which nations may control environmental measures without breaking trade and investment agreements are being shaped by these tensions. Corporations are increasingly using Investor-State Dispute Settlement (ISDS) systems to contest national climate legislation. These incidents show how difficult it is for governments to strike a balance between environmental laws and investor rights. According to the Energy Charter Treaty (ECT), the German energy corporation RWE filed an ISDS lawsuit against the Netherlands in RWE v. Netherlands, claiming that the government's intention to phase out coal power stations by 2030 was a violation of investment safeguards. RWE raised worries about the potential for ISDS procedures to be used to subvert legal climate laws by requesting compensation for lost earnings. In a similar vein, UK-based Rockhopper exploitation sued Italy in Rockhopper v. Italy for prohibiting offshore oil and gas exploitation. Despite Italy's environmental justification for the prohibition, the jury granted Rockhopper more than $190 million in damages. This decision emphasises how ISDS's ability to let governments to enact climate policy without incurring hefty financial penalties is limited.

The Swedish energy corporation Vattenfall contested Germany's plan to phase out nuclear power in the landmark case of Vattenfall v. Germany

(2012)[147]. The case, which was resolved for an unknown amount, showed how ISDS proceedings can compel nations to make expensive settlements while enacting energy changes. In a related case, Uniper v. Netherlands (2022)[148], a German energy firm called Uniper claimed damages for the Dutch coal phase-out strategy. These incidents highlight the pressing need to update ISDS procedures so that environmental regulations are not sacrificed for investor rights. When assessing whether trade policies connected to climate change adhere to international trade regulations, the World Trade Organisation (WTO) is a key player. A number of seminal decisions shed light on the relationship between trade commitments and environmental protection measures. The WTO ruled in the 2007 Brazil-Tyres Case[149] that Article XX of the General Agreement on Tariffs and Trade's (GATT) environmental exclusions supported Brazil's import restriction on retreaded tires. This decision confirmed that, when backed by science, environmental preservation may serve as a legitimate defence for trade restrictions. Similar to this, the WTO established a precedent that environmental preservation might support trade restrictions under GATT Article XX in the US-Shrimp Case (1998)[150], when the US was granted permission to ban shrimp imports from nations that did not utilise turtle-excluder devices. The WTO upheld the EU's ban on seal goods in the EC-

[147] *Vattenfall AB v Federal Republic of Germany* (ICSID Case No ARB/12/12) (Award, 2012).
[148] *Uniper SE v The Kingdom of the Netherlands* (ICSID Case No ARB/21/22) (Award, 2022).
[149] Brazil — Measures Affecting Imports of Retreaded Tyres, WTO Doc WT/DS332/AB/R (adopted 17 December 2007).
[150] United States — Import Prohibition of Certain Shrimp and Shrimp Products, WTO Doc WT/DS58/AB/R (Appellate Body Report, 6 November 1998).

Seals decision (2014)[151], another significant decision, because of ethical concerns about animal suffering. This significantly broadened the range of acceptable trade restrictions based on environmental and ethics.

Another dimension was introduced in the 2014 China-Rare Earths Case[152], in which the WTO rejected China's export bans on rare earth minerals, despite the nation's claim that the bans were required for environmental preservation. These decisions show that although environmental measures are allowed under WTO rules, they must be carefully justified in order to overcome legal challenges. As nations enact tough climate measures, new trade conflicts are arising, prompting concerns about whether economic liberalisation and climate obligations are compatible. Imported commodities from nations with laxer environmental regulations are subject to carbon levies levied under the European Union's Carbon Border Adjustment Mechanism (CBAM). China, India, and other developing countries contend that CBAM discriminates against non-EU manufacturers, in violation of WTO regulations. The legitimacy of trade policies relating to climate change might be redefined if this case is challenged.

Likewise, trade disputes with the EU, Canada, and South Korea have been triggered by the US Inflation Reduction Act (IRA). Critics claim that the IRA's renewable energy subsidies favour US-based manufacturers, perhaps in violation of WTO regulations pertaining to fair competition and non-discrimination. The Australian government has also been under fire for limiting coal exports in order to meet climate targets. Coal-producing

[151] European Communities — Measures Prohibiting the Importation and Marketing of Seal Products, WTO Doc WT/DS400/AB/R and WT/DS401/AB/R (Appellate Body Report, 18 June 2014).
[152] China — Measures Related to the Exportation of Rare Earths, WTO Doc WT/DS431/AB/R (Appellate Body Report, 26 August 2014)

countries have filed legal challenges, claiming that the limits are against international trade accords. The need for more precise regulations on climate-based trade policy has also come up in WTO negotiations as a result of the rising concern over green protectionism, which is the practice of using environmental measures as covert trade barriers. In order to keep litigation from undermining climate action, these new lawsuits highlight the necessity of international cooperation in trade policy connected to climate change. Legal reforms are urgently needed, as seen by the growing number of conflicts involving trade, investment, and climate policy. To stop investors from suing governments over legal climate initiatives, ISDS procedures need to be changed by adding environmental exclusions to investment treaties. More openness and equity in conflicts pertaining to climate change might also be ensured by switching to a Multilateral Investment Court system. A rising understanding of the need to stop outmoded investment agreements from impeding climate progress is seen in the current campaign to modernise the Energy Charter Treaty (ECT). Clearer guidelines for climate-related trade measures under Article XX of the GATT and the creation of a WTO Climate Agreement are necessary to modernise WTO rules and ensure uniformity in the application of trade rules to environmental policy.

Another important step is strengthening international climate treaties, which may involve extending the Paris Agreement to include investment and trade clauses that shield climate policies from legal challenges and promoting the adoption of trade policies that support the Sustainable Development Goals of the UN. The function of dispute resolution procedures should also change, with a stronger focus on arbitration and mediation that place sustainability ahead of monetary damages. The future of international trade

and investment law is being shaped by legal battles surrounding climate initiatives. The incidents under discussion highlight the increasing conflict between environmental legislation and business interests. Businesses continue to contest these policies under current trade and investment agreements, resulting in protracted legal fights, even as governments attempt to implement higher environmental requirements. The obstacle is in making sure that environmental and commercial laws are combined into a logical legal system that supports sustainable development rather than functioning independently. To modernise trade and investment regulations in line with climate goals, governments, legal experts, and international organisations must collaborate. In order to reconcile international commerce with environmental sustainability, it is imperative that international treaties be strengthened, WTO regulations be updated, and ISDS procedures be reformed. Legal disputes will remain a major barrier to accomplishing climate objectives in the absence of these measures. It is imperative that these legal issues be resolved immediately because if trade and climate policies are not balanced, environmental goals will be compromised, and investors, international markets, and future economic stability will all be put in jeopardy.

4. Lessons from the Frontlines: Case Studies and Best Practices in Climate Trade Law

Significant case studies and best practices that offer important insights into how countries and organisations manage the nexus of trade, investment, and environmental policy have been produced by the changing legal landscape of climate-related trade and investment disputes. These instances highlight the difficulties and possible solutions in striking a balance between climate

sustainability and economic growth while maintaining adherence to international legal frameworks. The Carbon Border Adjustment Mechanism (CBAM) of the European Union is among the most prominent case studies. In order to stop carbon leakage, the EU implemented CBAM, which imposes levies on imports from nations with laxer environmental laws. Since developing nations contend that CBAM discriminates against non-EU producers and contravenes World Trade Organisation (WTO) regulations, this policy has generated a lot of discussion. Nonetheless, the EU insists that CBAM is an essential instrument to guarantee that bloc industries stay competitive as they shift to low-carbon manufacturing. The significance of creating climate trade laws that respect international trade commitments and prohibit environmental dumping is a major lesson to be learnt from this case. To lessen the economic impact of CBAM, the EU has held lengthy diplomatic talks and is providing impacted nations with financial and technical assistance.

The United States Inflation Reduction Act (IRA), which offers substantial subsidies for the development of renewable energy, electric vehicles, and other climate efforts, is another useful case study. The IRA's provisions favour domestic sectors, which opponents claim may violate WTO non-discrimination standards. This has led to disagreements with the European Union, Canada, and South Korea. In order to resolve issues, the US has held bilateral and multilateral talks, exemplifying the best practice of proactively resolving trade disputes through discussion and negotiated agreements as opposed to legal action. On the other hand, Australia's move to limit coal exports is an example of how trade restrictions intended to lower carbon emissions may cause diplomatic problems. China and India, two nations that depend on Australian coal, have expressed concern that these limitations go

against the fundamentals of global commerce. In order to prevent economic inequality and trade disputes, this example emphasises how crucial it is to make sure that trade policies driven by climate change are implemented with international cooperation. Phased transition plans, stakeholder involvement, and the creation of alternate energy supply chains to lessen reliance on coal are a few excellent practices that came out of this circumstance.

Dispute resolution procedures are also part of best practices in climate trade legislation. An important step in striking a balance between environmental sustainability and investor protection has been the modernisation of the Energy Charter Treaty (ECT). To make sure that the ECT does not unfairly benefit fossil fuel investors at the expense of climate policy, nations including France, Spain, and Germany have pushed for revisions. This emphasises how crucial it is to revise investment agreements to take into account contemporary environmental goals. Furthermore, there is growing understanding of the role that international arbitration plays in climate trade conflicts. Arbitration tribunals have found in favour of fossil fuel businesses contesting environmental rules in instances such as Vattenfall v. Germany and Rockhopper v. Italy. Nevertheless, more recent arbitration frameworks are being developed to include environmental and social governance (ESG) factors in the resolution of investment disputes. Trade agreements are increasingly including provisions that let nations enforce environmental laws without fear of severe legal consequences. This change is an example of excellent practices in trade law that other countries might follow to protect their climate policy. The effectiveness of carbon trading programs, like the European Union carbon Trading System (EU ETS), is another example of best practices. By enabling businesses to exchange carbon permits, this market-based strategy for carbon reduction provides an

affordable means of encouraging emission reductions. Similar initiatives in China and Canada have been modelled after the EU ETS, proving that market processes may be matched with both environmental and economic goals. Emissions trading programs' success serves as a reminder of how regulatory frameworks might be set up to guarantee compliance and advance sustainability. China's export limits on rare earth minerals, which are necessary for green technology like wind turbines and electric vehicles, were at the centre of one of the more heated trade conflicts pertaining to climate change. Despite China's claim that such limits were required for resource conservation and environmental preservation, the World Trade Organisation declared in the 2014 China-Rare Earths Case that they were in violation of trade agreements. The difficulty of striking a balance between international trade commitments and national resource management is demonstrated by this scenario. The development of international cooperation on key minerals, as seen by agreements between the US, the EU, and other major economies to diversify supply chains and avoid monopolisation of vital raw resources, is a best practice that has resulted from this conflict. Another effective practice for guaranteeing adherence to climate trade regulations while promoting economic expansion is public-private partnerships, or PPPs. In order to create green finance programs that promote sustainable investments, governments are increasingly collaborating with corporations and global organisations. A global standard for sustainable investing strategies has been produced by the Task Force on Climate-Related Financial Disclosures (TCFD), which has created standards to help businesses incorporate climate risks into financial decision-making. The harmonisation of trade and sustainability norms is another illustration of climate trade law best practices. In order to make

sustainability pledges legally binding, the World Trade Organisation (WTO) and the United Nations Conference on Trade and Development (UNCTAD) have been collaborating with states to include climate issues into trade agreements. Countries can establish legally enforceable pledges that avert future conflicts and encourage sustainable trading practices by integrating environmental safeguards into free trade agreements.

Finally, it is impossible to ignore how climate litigation influences trade and investment policy. Environmental organisations have filed lawsuits against nations including the Netherlands and Germany, calling for more stringent climate policies, while businesses have challenged restrictions under ISDS procedures. The harmonisation of trade and sustainability norms is another illustration of climate trade law best practices. In order to make sustainability pledges legally binding, the World Trade Organisation (WTO) and the United Nations Conference on Trade and Development (UNCTAD) have been collaborating with states to include climate issues into trade agreements. Countries can establish legally enforceable pledges that avert future conflicts and encourage sustainable trading practices by integrating environmental safeguards into free trade agreements. Regardless, it is impossible to ignore how climate litigation influences trade and investment policy. Environmental organisations have filed lawsuits against nations including the Netherlands and Germany, calling for more stringent climate policies, while businesses have challenged restrictions under ISDS procedures.

5. Conclusion and Recommendations

As countries enact aggressive climate policies, the legal landscape at the nexus of trade, investment, and environmental law is changing quickly.

Investor-state conflicts draw attention to the conflict between state sovereignty and corporate interests in environmental protection, highlighting the necessity of legal clarity in striking a balance between these conflicting agendas. Green subsidies' legality is still a hotly debated topic that raises concerns about how to promote climate action while upholding fair competition under WTO regulations. Due to the ongoing legal dangers posed by ESG rules, compliance frameworks against financial wrongdoing and greenwashing must be strengthened. Although trade organisations like the WTO find it difficult to incorporate climate-based trade restrictions into current frameworks, international accords like the Paris Agreement offer a basis for forming regulatory regimes. Modernisation of trade agreements, ISDS reforms, and improved WTO dispute resolution procedures are important tactics to avoid conflicts from impeding climate progress. For long-term sustainability and to guarantee that economic policies are in line with international climate obligations, a healthy balance between trade, investment, and climate law is essential. The world community can establish a trade and investment system that promotes rather than impedes climate goals by enacting comprehensive legislative frameworks and working together internationally.

The implementation of a number of important suggestions is necessary to provide a more sustainable and legally sound approach to trade and investment conflicts connected to climate change. International trade agreements should be updated by policymakers to specifically include climate goals, guaranteeing that environmental sustainability becomes a fundamental component of economic governance. To stop companies from abusing these frameworks to undermine legal climate measures, reforms to ISDS processes should be implemented, striking a balance between investor

rights and state authority over environmental regulation. In order to ensure equitable settlement of trade disputes connected to climate change, the WTO should fortify its dispute resolution procedures and include explicit rules regarding the legitimacy of green trade policy. Enhancing international collaboration is also necessary to harmonise ESG and green finance legislation and establish internationally accepted standards that will stop regulatory arbitrage and greenwashing. By taking these steps, international investment and trade policy may be brought into line with climate pledges, promoting a more resilient and sustainable economic system.

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VII

CLIMATE CHANGE, HEALTH AND HUMAN RIGHTS: A LEGAL PERSPECTIVE IN THE ERA OF GLOBALISATION

Jemima B S*

ABSTRACT

As the planet is facing unparalleled environmental and climatic changes owing to anthropogenic activities, the consequential effects have caused serious health issues, which further led to basic human rights violations. Severe heat waves in the northern part of India and air pollution in Delhi are very recent examples which show the significance of the issue. Also the health concerns caused as a result of climate change accelerate the violation of the fundamental right to live in a pollution free environment. Again, climate change has detrimental effects on women, infants, children, the elderly, indigenous communities, low-income groups, coastal people etc. The basic human right to live in a safe, clean, and pollution-free environment is likewise threatened by these environmental stresses, which significantly lower quality of life. Systemic injustices are made severe by this unequal burden, which exacerbates already-existing socioeconomic and health disparities. In this regard, the present study aims to examine the connections among climate change, related health hazards, and consequent human rights abuses. By analysing relevant international treaties, national legal systems, and policy tools on the climate change, the study sheds light

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on the associated health concerns and how it lead to human right violations by analysing international and national instruments.

Keywords: *climate change, SDGs, right to health, human rights*

1. Introduction

The major concern of all the environmental issues is that, they have no geographical borders. Environmental issues in one place lead to serious climatic issues and health concerns across the globe, rendering a concern for the whole planet. The environmental issues and the associated climate changes not only affect the ecosystem, biodiversity and economy but also the very existence of the mankind. Climate change is defined as a shift in climate that is directly or indirectly caused by human activity that modifies the global atmosphere's composition, on top of the natural climate variability seen over similar time periods.[153] Climate change is mostly caused due to anthropogenic activities like over exploitation of natural vegetation, burning of fossil fuels etc. This causes the change in the atmospheric conditions due to the increased presence of gases like greenhouse gases in the atmosphere which further leads to global warming and thereby altering the level of the heat trapped in the atmosphere. Over time, these contribute to climate change. Severe climate changes are not good for vegetation, animals and the health of human kind. It has many adverse effects. "Adverse effects of climate change" refers to modifications to the physical environment or biota brought about by climate change that have a major negative impact on the resilience, productivity, or composition

[153] UNFCCC, Art 1 (adopted 9 May 1992) https://unfccc.int/resource/docs/convkp/conveng.pdf, accessed 3 March 2025.

of managed and natural ecosystems, on the functioning of socioeconomic systems, or on the health and welfare of people.[154] It includes the impact on human health leading to human rights violations, effects on flora and fauna, falling of ground water level, reduced rainfall etc. Of the many adverse effects of climate change, the paper primarily focuses on the health-related aspect of human kind and human rights violation.

2. Literature Review

In the journal article, "Climate Change at a Global Concept: Impacts and Adaptation measures"[155], the researchers have studied the impact of the climate change, especially in the agricultural field. Climate change has a devastating impact on agriculture due to change in the temperature and precipitation levels which affects the food security. The major contributors of the climate change and related issues are found to be anthropogenic activities.

The article "Climate Change: Causes, Effects and Mitigation Measures-A Review"[156], the authors assess the climate change, potential reasons for climate change, effects and the mitigation measures. The article also deals with the approach towards climate change by both the developed and developing nations and how they are different.

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[154] Ibid

[155] Suleiman Usman, James O Jayeoba and AM Kundiri, 'Climate Change at a Global Concept: Impacts and Adaptation Measures' (2024) 14(6) *International Journal of Environment and Climate Change* 445 https://doi.org/10.9734/ijecc/2024/v14i64242, accessed on 3 march 2024.

[156] US Onoja, UME Dibua and AA Enete, 'Climate Change: Causes, Effects and Mitigation Measures—A Review' (2011) 17(4) *Global Journal of Pure and Applied Sciences* 469.

There are many literatures that deals with climate change and related issues on climate change. But there is a need for an interdisciplinary approach to assess the impact of climate change on human health and how it leads to the violation of human rights, as right to clean, safe and healthy environment is identified by several nations and international instruments.

3. Impact of Globalisation on Climate Change

One of the factors that contributed to climate change is globalisation. With the proliferation of information and communication technology, the concept of globalisation has entered a new phase. Globalisation has caused the increased exchange of goods and services leading to more logistics, urbanisation, which is a sub set of globalisation has led to the over exploitation of natural resources, over population and concentration of more people around cities has led to rampant deforestation which also led to fall in ground water level, increased trade led to movement of people across the globe and availability of resources without geographical borders, which further led to the emergence of the concept of global village etc. Though many of these have made human life easier and accessible, it has put an additional burden on the environment. All these have come into existence by sacrificing the environment which in turn led to climate change.

Of the 17 Sustainable Development Goals (SDGs) of the UN, which are to be achieved by the year 2030, the 13th goal is the goal on climate action. The relevance of this goal is that if climate got disrupted, it automatically affects the other Sustainable Development Goals like SDG 3 which is Good health and well-being, SDG 6 which is clean water and sanitation, SDG 11 which is Sustainable cities and communities etc. Therefore, the topic holds

immense relevance as climatic action forms the basis from which other goals are to be achieved.

4. Climate Change and Human Health

Climate change has a direct effect on human health as it leads to diseases like that which arises out of extreme weather conditions and unhealthy environment. Also it has detrimental effects on women, infants, children, elderly, indigenous communities, low-income groups, coastal people etc. They are the most affected groups. Regarding the people who live in coastal areas, it affects their livelihood and shelter which leads to fundamental right violations.

4.1 Heat waves: The rise in temperature due to the release of greenhouse gases like chloro fluro carbons (CFCs), carbon dioxide etc causes global warming which leads to intolerable heat waves. For example: India witnessed severe heat waves last year especially in the northern part of the nation. Also Delhi, the national capital of India is also undergoing severe air pollution in the recent years. The report says that in 2024, 48,156 Suspected Heatstroke Cases (SHC), 269 Suspected Heatstroke Deaths (SHD) and 161 Confirmed Heatstroke Deaths (CHD). Compared to the last 2 years, SHC is reported to have increased while SHD and CHD are reduced.[157]

For dealing with the health impacts due to the climate change, India launched National Programme on Climate Change and Human Health

[157] Dr. Purvi Patel (Sr. Consultant, NPCCHH), *Heat-Health Preparedness & Response Activities, National Programme on Climate Change & Human Health 2024 Report* (National Centre for Disease Control, 2024), https://ncdc.mohfw.gov.in/wp-content/uploads/2024/12/Report-of-Heat-Related-Activities-2024_NPCCHH.pdf, accessed 3 March 2025.

(NPCCHH) which is a flagship health programme under the Ministry of Health and Family Welfare. Preparing and responding to the health issues that arises due to severe climate changes is the aim of this programme.

4.2 Respiratory issues: Air pollution has a serious impact on our respiratory health. Persons suffering from asthma are prone to such lung related issues due to air pollution. Increased air pollution leads to asthma, certain kinds of allergies issues related to lungs (pulmonary diseases) etc. The study conducted by the Central Pollution Control Board in 2008, has identified significant associations with the air pollution of Delhi and health outcomes. The findings were compared with a rural control population in West Bengal and it was found that Delhi had 1.7-times higher prevalence of respiratory symptoms compared with rural controls ($P < 0.001$) and also the Prevalence of asthma and physician-diagnosed asthma among the people of Delhi was higher than in the other areas[158]

4.3 Psychological distress: It also affects the mental health of the people by causing anxiety, loss of hope etc due to the polluted nature of the environment they live in.

4.4 Infectious diseases: Another impact of climate change in the increased diseases and malnutrition. Changes in the atmospheric conditions leads to emergence of diseases like malaria, dengue, viruses etc. Climate changes pose a great advantage to certain viruses giving them an ample condition for growth and proliferation.

[158] Rizwan S, Nongkynrih B, Gupta SK. "Air pollution in Delhi: Its Magnitude and Effects on Health". (PubMed Central, 15 August 2013), https://pmc.ncbi.nlm.nih.gov/articles/PMC3612296/#ref10, accessed 3 March 2025.

5. Judicial And Constitutional Response to Human Health and Climate Change

Conservation and preservation of environment for the better health and wellbeing of the citizens has been identified by the Indian constitution at the time of formation itself. Indian judiciary has also taken many measures for dealing with the environmental concerns, related climatic changes and human health aspect. Indian constitution, under Article 48A of the Constitution, provides that "the State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country"[159]. Article 51A (g), which is a fundamental duty stipulates that "it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures"[160].Though these are not justiciable rights of a person, these indicates that the constitution underlines the need and importance to protect the biodiversity in order to mitigate the adverse effects it would pose on the environment as well as human beings.

The supreme court of India in many cases highlighted the importance of nature, climate and health. In *M K Renjth Singh v. Union of India*[161] court held that it is the duty of the state to maintain ecological balance and hygienic environment and court identified right against the adverse effects of climate changes and right to live in a pollution free environment as fundamental rights under art 21 of the Indian constitution. Court also held that "Enjoyment of life and its attainment including their right to life with human dignity encompasses within its ambit, the protection and

[159] Constitution of India, 1950 art 48A.
[160] Constitution of India 1950*, art 51 A(g).*
[161] *M K Renjth singh v. union of india [*2024] 3 S.C.R. 1320.

preservation of environment, ecological balance free from pollution of air and water, sanitation without which life cannot be enjoyed."[162]

In *Virendra Gaur and Ors. V. State Of Haryana and Ors*[163]., Court held that it is not only the duty of the state but also the duty of the citizens to maintain a hygiene, healthy and clean environment

In *Karnataka Industrial Areas v. Sri C. Kenchappa & Ors*[164], Court considered the deadly effects of development on the ecosystem and held that the environmental measures must anticipate, prevent, and attack the causes of environmental degradation. "Where there are threats of serious or irreversible damage; lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation."[165]

In *M.C. Mehta vs Kamal Nath & Ors* [166], court by pronouncing public trust doctrine as the part of Indian system reiterated the need for the conservation of ecosystem and natural resources for the protection of human life and environment.

Therefore, Indian constitution as well as Indian judiciary have recognised the importance of preservation of ecosystem for climatic action, protection of human health and well-being as the basic human rights of the citizens.

6. Interlink Between Climate Change, Health and Human Rights

Climate change not only affects the ecosystem and environment, but also affects the human rights enshrined under the national as well as international

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[162] Ibid.
[163] *Virendra Gaur and Ors. V. State Of Haryana and Ors* [1995] 2 SCC 577.
[164] *Karnataka Industrial Areas v. Sri C. Kenchappa & Ors* [2006] 6 SCC 371 (SC).
[165] *Ibid.*
[166] *M.C. Mehta vs Kamal Nath & Ors* [1996] SC 711 (SC).

instruments. Firstly, right to health has been recognised under international instruments like UDHR, Art 25, ICESCR, Art 12 etc which includes access to healthcare, clean water, sanitation facilities, adequate nutrition etc. climate change causes many health concerns like pulmonary diseases, infectious diseases, heat burns etc which in turn affects the human right to lead a healthy life. Secondly, right to shelter which is another recognised human right under the international instruments like ICESCR, Art 11. Storms, hurricanes, cyclones and other natural calamities caused out of climate change causes loss of shelter to many people, especially people living in coastal areas. They are prone to the calamities out of climate change and are displaced out of their homes, which affects their human right to have a shelter. Thirdly, right to food is a basic human right under Art 25 of UDHR. The loss of crops and cultivations lead to food shortage which in turn leads to the violation of the right to access to food. Fourthly, right to clean and safe water is one of the Sustainable Development Goals (SDG 6) of UN. Climatic changes and the associated problems cause fall in ground water level, reduced precipitation which affects the right to clean and safe water. Fifthly, right to livelihood, implicitly mentioned in international instruments, particularly affects the people in coastal areas, as those who rely on oceans for their livelihoods are increasingly displaced due to the impacts of climate change and extreme weather events. The problem is that these people don't know anything other than their traditional occupation rendering them jobless which also makes them climate refugees.

Therefore, extreme weather conditions affect not only the health of the people but also various human rights which are recognised in the national and international instruments. So, a comprehensive approach to protect people from the adverse effects of the climate is required at a global level.

7. Balancing Climate Change, Health and Human Rights

There are many intentional instruments dealing with climate change and human rights aspect like UNFCCC (United Anions Framework Convention on Climate Change), Paris agreement, 2015, Kyoto agreement etc. One of the guiding principles of UNFCCC is common but differentiated responsibilities (CBDT) which stipulates that all nations are responsible for addressing climate issues but developed nations have more responsibility. Also, the principles of equity, sustainable development, precautionary principle etc. have been recognised in the convention. The ultimate aim of the convention is to reduce greenhouse gases that would lead to climate change problems.

Kyoto protocol adopted in 1997 came into force in 2005 aimed at the reduction of greenhouse gases of industrialised nations. The methods like emission reduction targets and clean development mechanism and joint implementation are adopted to serve its purpose. However, the treaty is criticised because most of the nations withdrew from the protocol, and it lacked participation from the nations.

Paris agreement adopted in 2015 is another treaty on the climate change. It has a more inclusive approach than the Kyoto protocol by including the developed and developing nations in setting climate targets. The policies on temperature limitation, nationally determined contribution, global stocktake etc are some of the measures for the protection of climate change and adverse effects of climate change.

These conventions try to balance the climate change and human rights aspects through its policies. Apart from these, there are many conventions and protocols on climate change aspect and human rights aspect to balance

the protection and conservation of environment and climate change and thereby protecting the human rights and health of the world.

8. Challenges And Recommendations

The right to healthy environment has been recognised by more than 150 nations out of 196 nations of the UN. It is there in the international instruments also. The problems with the environment issues is that it is the root from which other rights are established. Violation of right to healthy environment causes climatic issues which further violates the right to health, right to food, right to pollution free environment etc. Therefore, the root lies in the healthy environment. In addition to that, environmental issues are global issues and it require global solutions as well.

The ICCPR which protects civil and political rights does not contain the right to a healthy environment in an explicit way. It is only implicitly mentioned in the covenant under Art 11. It is only in the general comment no. 36 of the ICCPR in 2018 right to healthy environment was recognised. The Human Rights Committee (HRC) which is a key body established by the International Covenant on Civil and Political Rights (ICCPR), is responsible for supervising the nations in the implementation of the provisions of the ICCPR. As the right to healthy environment was not there explicitly before 2018, the committee is not well equipped to deal with such complex legal issues and also it deals with the individualised problems of the member nations only. It lacks a global approach. A combined and concerted effort is required from the part of international organisations.

Therefore, active measures and policies are required to ensure more inclusivity of the nations in its implementation as environmental issues are a global challenge which needs to be addressed globally.

Secondly a state level approach to reduce the environment degrading activities is required. For example, in 2021 Maldives banned high leakage plastics in the country as it affects the coral reefs in the island, the ABC booklet of Vietnam and the Green school of Indonesia are some of the examples. The state efforts matters to contribute to the global effort.

Thirdly, climate change mostly affects the children. It is the children and elderly who are vulnerable to environment and climate change issues. It affects their health and metabolism

Art 29 of the **Convention on the Rights of the Child (CRC),** adopted by the **United Nations** in **1989,** recognises the holistic development of children. Environmental issues related climate changes and the health concerns pose a problem to the children as they are the threat multipliers. Therefore, robust guidelines for the protection of children are required

9. Conclusion

Climate change has become a critical area of concern, especially the impact it has on the health and human rights of the global community. Though there are many international instruments dealing with climate action, the frameworks lack essential foundation especially in enforcement part and holding the states accountable for their action. Hence, a robust response from the part of the global community is required for achieving climate justice without compromising basic human rights. A unified and cooperative approach is crucial in mitigating climate change issues and its potential impact on the human health which further leads to violation of the human rights International and national approaches that focus on identifying the causes of climate change and addressing them will be more effective in the long run than merely focusing on its consequences.

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VIII

THE ROLE OF POLICY AND GOVERNANCE IN CLIMATE CHANGE MITIGATION:

A SOCIO-LEGAL PERSPECTIVE

Dr. Kusuma vati*

ABSTRACT

The policy and governance play a crucial role in climate change mitigation by establishing legal frameworks, setting emission reduction targets, incentivizing sustainable practices, and facilitating collaboration between different stakeholders, ultimately shaping societal behavior and driving necessary systemic changes to combat climate change through regulations, market mechanisms, and public awareness campaigns. Governments enact laws and regulations to set standards for greenhouse gas emissions, mandate renewable energy usage, and control activities like deforestation, providing a legal basis for enforcement and accountability. Global treaties like the Paris Agreement establish shared goals and commitments for climate change mitigation, creating a framework for international cooperation and accountability. Effective communication and education are crucial to build public support for climate policies and promote behavioral change. Robust mechanisms for monitoring, enforcement, and sanctions are needed to ensure that entities comply with climate regulations. As scientific understanding of climate change evolves, legal frameworks need to adapt

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to address new challenges. Overall, fighting climate change effectively means having regulations and government structures that give legal advantages to sustainable practices, address fairness issues and include many stakeholders to achieve major cuts in carbon emissions. This article focuses on the issue of climate change governance and looks at how national governments help set up guidelines, strategies and activities aimed at dealing with climate change.

Keywords: *Climate change, mitigation, incentivizing sustainable practices, deforestationlegal mechanisms, greenhouse gas emissions, diverse stakeholders*

1. Introduction

Climate change happens when there is long-lasting change in the average and variability of climate features as determined by models or analysis. Climate change could include natural processes or could come from outside sources like changes in solar cycles, eruptions of volcanoes and actions people take to change the earth's air or land. In the "United Nation Framework Convention on Climate Change (UNFCCC)", climate change means "a change in climate that humans cause through their activities and that is extra to any normal, natural variations observed over the same amount of time".[167] According to the UNFCCC, human actions affecting the atmosphere are treated differently from natural climate variability. Laws and policies known as climate legislation set the rules for managing climate change by providing its legal structure. The term is often applied to cover

[167] United Nation Framework Convention on Climate Change, 1992 Article, 1.

acts, decrees and policies created by both legislative and executive branches of government. The main goal is to prevent and address climate change issues using policies on mitigation, adaptation and handling disaster risks. The label climate 'framework legislation' refers to certain key climate laws that bridge national and international objectives. Framework climate laws have some or all of these qualities: they guide the national policy on climate change and are passed by the legislative branch of the government.[168]

2. Need for Environmental Law

It was decided at the First United Nations Conference on Human Environment in Stockholm, in June 1972 (5-16 June), that all nations share the responsibility to care for and develop the environment today as well as in the future. As a result, the Conference encouraged every government and person everywhere to help secure and enhance the human environment. As a result of the Conference, twenty-six important points were established and called the "Magna Carta on Human Environment".[169] In that year, "Prime Minister Indira Gandhi", the first State leader, delivered a speech at the conference on issues like environment pollution, degradation of nature and keeping a balance in ecology. After the country was involved in the Conference, India adopted new environmental laws. It is now clear to many people that protecting and strengthening the environment is key for improving human, plant, animal and economic conditions. 'The Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Environment (Protection) Act, 1986, National Environment Tribunal Act, 1995,' as well as other major

[168] Morgan O, Ahern M, Cairncross S. Revisiting the Tsunami: Health consequences of flooding. (PLoS Med 2005) 491.
[169] Stockholm, in June 1972 (5-16 June).

environmental laws, mention that the Act was created after India made a promise at the U.N. Conference on the Human Environment at Stockholm in June 1972 to take steps for preserving the environment's quality. The Supreme Court has repeatedly explained that the U.N. Conference on Human Environment made us understand the importance of caring for nature. It was noted by the IMF that the idea of sustainable development was first established at the Stockholm conference of 1972. Today, people see this principle as a binding rule under the Customary International Law.

3. The Indian Constitution and environment protection

To begin with, the original Indian Constitution in 1950 did not treat environmental protection as a separate right, so no environmental laws were created at that time. Because of this, the parliament was inspired by the conference's findings on pollution and decided to create Article 48A and Article 51A (g) to safeguard and strengthen the environment which they enacted in 1976 through the 42nd Constitution Amendment Act. The Act included some changes to the Seventh Scheduled in the Constitution.[170]These changes are therefore known as the following- The government is required by Article 48-A to look after the country's forests, wildlife and environment. Indian law requires each person to care for and supervise the environment, forests, lakes and wildlife and to ensure the conservation of animals and items of their kind. Item 17-A on the Concurrent List under Schedule Seventh deals with Forests, whereas 17-B and 20-A are responsible for wild animals, birds, population control and family planning. As a result, matters concerning the environment such as forests, animals, population and family planning, came under Parliament's

[170]Forty-Second Constitution Amendment Act, 1976.

jurisdiction as numerous State List II sections were changed to List III (Concurrent List). All areas should follow the same laws, so the updates were carried out.[171]" The issue of the state's role in preserving natural resources was discussed in the Intellectuals Forum, Tirupathi vs. State of Andhra Pradesh case. Since the case involved a dispute over protecting the environment and developing the society, the court debated its legal questions. According to the ruling, most countries now accept that the State has an obligation to look after the environment. As a result, national governments in International Law are expected to deal with environmental problems occurring within their territory. "The United Nations Conference on Human Environment held in Stockholm in 1972" (the Stockholm Convention) made it clear that this was India's responsibility. So, the court decided that the government must uphold and guard the country's natural resources. Further explaining their decision, the court spoke about sustainable development, the public trust doctrine and intergenerational equity, describing their history and current uses.[172] As part of making this decision, the court reviewed the Brundtland Report, called 'Our Common Future'. According to the court, the State is required by law to look after nature resources as a trustee, based on the Public Trust doctrine. It means the State must protect streams, lakes, marsh lands and tide lands for the public, but can release its responsibility if it is in line with the original goal of the trust.

[171]Jeriwala, C.M: "The Constitution 42nd Amendment Act and the Environment" in Legal Control of Environmental Pollution (Indian Law Institute,New Delhi1980)3-4.

[172] The United Nations Conference on Human Environment held in Stockholm in 1972.

4. Right to Life and Right to Clean, Healthy Environment

Environmental laws have been made by both parliament and state legislatures to recognize a clean environment as something that belongs to everyone. Since we must survive and the environment needs to remain balanced, everyone deserves a healthy environment. Any act that ruins or pollutes the environment is regarded as a breach of everyone's right to a clean environment.[173]During the Stockholm Conference in 1972, it was stressed that everyone should enjoy freedom, equal rights and dignity and good health.[174]Chapters I to III, including Articles 12 to 35, lack any reference to environmental pollution or changes that upset the environment. This is why Supreme Court and State High Courts in India have played a role in more precisely establishing environment protection as a basic right. Articles 14 (Right to Equality), 21 (Right to Life) and 19(1)(g) (Right to Freedom of Trade and Commerce) have appeared and been used by the Indian Courts in decisions relating to the environment. We will learn about the right to a clean and healthy environment and explore its relationship to the main rights included in the Chapter III of the Indian Constitution. Madras High Court,He has pointed out that modern law identifies environmental rights as part of the third group of rights, known as 'third generation rights'. The Political Rights are part of the first group, while the rights of the second group deal with social and economic matters. This is why protecting people from noise became an important part of the new human rights concept in the 1990s. The Constitution has included Articles 21, 48-A and 51-A(g) which ensure that every person gets clean air, the State

[173]Mishra, R.P.: "Ecological Balance as a Human Right" (Environmental Law in India 1996) 20-26.
[174]Stockholm Declaration, 1972-Principle 1.

pays attention to the environment and citizens are responsible for keeping the environment healthy.[175] Several times, the Supreme Court has stated what it understands the term to mean. This plan, says the court, should serve the constitution's policy of sustainable development and be implemented. Even though sustainable development is considered a good idea, the court warns that care should be taken when deciding what comes first in environmental protection or economic development. On the other hand, we cannot forget about the needs of those to come, though the current demands of our society are also valuable.[176]

5. Climate change mitigation Strategies

Climate change is caused by a mix of greenhouse gases (GHGs) coming from fossil fuel use, agriculture, industry and deforestation. Their rising amounts in the atmosphere could substantially change the climate of the world over the next several generations. Companies could benefit from large-scale alterations in nature, but these changes might cause significant damage to livelihoods, activity in the economy, life conditions and people's health. On the other hand, working to cut GHGs could cost society a lot of money. The contribution of countries to increased atmospheric GHGs varies internationally, even though climate change is a global concern. The main damage from climate change will hit those who have the smallest role in causing it, mostly people in developing nations like India. According to PPP, in 2002 India emitted 0.4 ton of CO equivalent per 1000 US dollars which is under the worldwide average. The use of renewable energy in India for generating power is far better than what any industrialized nation can

[175] MP Jain, Indian Constitutional Law (7th Edition Lexis Nexis 2014) 1437.
[176] *Intellectuals forum, Trapathi v. state of AP* (2006) 3 SCC 549: AIR 2006 SC 1350, at p. 1363.

attain in a very long time, since renewable energy does not contribute to GHG emissions. Since economic growth leads to GHG emissions, India will have to see an increase in them as the economy grows from its present low rates. Any steps aimed at curbing India's GHG emissions, either through formal limits on emissions or indirectly, will slow down economic growth. In addition, by promoting energy efficiency, combining different types of fuels, including nuclear, hydro and renewable energy, pricing energy appropriately, mitigating pollution, planting more trees, improving mass transport and seeing faster growth in less energy-intensive service sectors, India takes a less harmful path in terms of greenhouse gases. Many argue that climate change mostly brought on by developed nations is affecting weather, ecosystems, agriculture, forests, water, coasts and the spread of disease carriers in India and elsewhere; however, India and other developing countries are not responsible for these issues. Tackling climate change and its impacts would almost certainly require a great deal of resources to prevent widespread hardship. For this reason, the following actions will form crucial parts of India's response to climate change:

(a) change in proportion with their abilities.

(b) Using approaches involving several countries, rather than just two or more countries or countries following their own policies.

(c) Each country is entitled to the same amount of global environmental resources per person.

(d) Focusing the priority on the right to development.

Recognize the main ways in which climate change affects India's water, forests, coastal areas, agricultural operations and the health of its population.

(f) Consider adjustments that should be made to handle future climate change and review opportunities to add these adjustments to programs for watershed management, coastal zones, forestry, agriculture and health.

(g) Help Indian Industry join the Clean Development Mechanism (CDM) by training them to find and prepare projects, also in the financial sector.

(h) Partner with developed and developing countries, both within and outside the organization, to help deal with sustainable development and climate change, all according to the guidelines of the UN Framework Convention Climate Change.

6. Government Initiatives to Mitigate Climate Change

As weather and climate change get stronger, more people develop climate sensitive illnesses. The UNFCCC, made in 1992 and the Kyoto Protocol, issued in 1997, are the principal legal tools countries use to control Climate change internationally. Annually, the COP to the Convention comes together to consider and decide on worldwide climate change matters and what countries have signed up for. It is instructed by Goal 13 of the sustainable development Goals to deal effectively and quickly with both climate change and what it brings.

The NAPCC being India's national strategy for fighting climate change came into being in June 2008. During those years, India became one of the few nations worldwide with one unified strategy for dealing with climate change. Officials had been pushing for a climate policy in Canada before both the G8 in Tokyo in 2008 and the Conference of Parties in Copenhagen in 2009. Because the NAPCC was formed quickly, discussiing what should be accomplished came before deciding how to accomplish them. The mission wasn't approved by the responsible ministries until six years had

passed since the study was presented. In the end of that age, the old government left and a younger government took the lead. Even though some climate steps were proposed by the Government, they did not fit with what was outlined in the National Adaptation Program of Climate Change. NAPCC responds to pressing national problems by creating and strengthening the programmes discussed in the Technology Document. It pairs efforts to move forward economically with positive effects those steps can have on climate change. It outlines ways to move forward on India's development aims as well as its climate-related objectives of getting ready for challenges and reducing emissions. The National Adaptation Plan centers on development around five or eight national oriented missions:

1. Pan India Ecological Habitat Transformation
2. Protecting the Himalayan Forest Edison Preservation
3. Government's Back to Basics Farming Qualification
4. Solar Power Technology Improvement Plan
5. Energy Savings Achievement Mission
6. A water sustainability plan covering the whole nation
7. Prime Minister's Climate Expert Mission
8. Growing the Green Through Campaign

The reconstituted PMCCC met on 19th January 2015 and assessed the progress of eight existing national missions, suggesting the formation of additional four missions to address Climate Change.

1. Wellness movement initiated across all states in India
2. Energy can be recovered from waste, as part of this Initiative.

3. Drive for Protecting the Coastal Zone
4. The wind energy system will expand through this strategy

At this time, the "Ministry of Health & Family Welfare" teamed up with the Ministry of Environment, Forests and Climate Change (MoEFCC) to introduce the Health Mission with guidance from the 'National Action Plan on Climate Change.' A group called the "National Expert Group on Climate Change & Health (NEGCCH)" was set up by the Ministry and led by Dr Vishwa Mohan Katoch to think of solutions and plans for handling diseases related to climate change.[177]

The challenges faced by NAPCC

1. Experts came up with the policy rather quickly. Ministries had a long time before their approval was given.
2. The central government was changed.
3. The sensors were not getting the job done.
4. There was very little money provided for these projects

7. Key Environmental Challenges:

Environmental problems suffered by the country are most closely linked to how poverty and economic growth relate to environmental damage. These challenges are closely connected to issues related to land, water, air and the plants and animals living on or around them. Population increases, incorrect choices in technology and what we consume, combined with poverty, cause changes in how people relate to the environment and support activities such as extreme farming, environmentally harmful industry and rapid but

[177]National Action Plan on Climate Change in June 2008.pp.16-19.

unplanned development of towns and cities. Nonetheless, the above factors only harm the environment through significant causes such as institutions that fail, thus leading to unclear or poorly enforced rights to natural resources, policies against conserving the environment (which could stem from financial policy), shortcomings in laws regulating the environment and restrictions on good governance. Poverty is frequently made worse by environmental degradation, especially among people living in rural areas, because such degradation reduces soil fertility, lowers the supply of drinkable water, pollutes the air, harms forest, decreases wildlife populations and impacts fisheries. It is clear that rural poor communities and particularly tribal ones, rely on nature, especially biodiversity, for their needs.

16. Conclusion

Climate change is threatening to slow down development for everyone, but most of all the poorest and those who are most vulnerable across the world. Changes in weather, increasing world temperatures that can harm food, water, energy and a way to earn a living and extreme events like rising sea levels that threaten coastal cities are all global and unmatched in scale. Although climate change is a challenge everywhere, India encounters more serious consequences than quite a few other countries. There is a serious risk to the nation from climate change, particularly because of its farmed land, high population, vulnerable coastlines and heavy use of fossil fuel. It is foreseen that extreme weather in India such as heat waves, droughts, floods and cyclones, will happen more frequently over the coming years, putting those at poverty's edge at additional risk and aggravating India's problems with society, finance and the environment. All in all, by taking part in world

climate negotiations and creating good climate policy, India has shown it can have a major role in finding fair answers for the global climate issue. Having these plans makes a variety of information and opportunities available to reproduce successful ways to protect the climate. Linking a new initiative for the climate to these policies could make it easier to gather and use existing resources and support from industry leaders.

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IX

G.I. LAW, CLIMATE CHANGE, AND INDIGENOUS RIGHTS: A LEGAL PERSPECTIVE FROM NORTHEAST INDIA

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ABSTRACT

Geographical Indication (G.I.) law is one of the very important laws which protects traditional knowledge of indigenous products, cultural heritage, and indigenous knowledge in Northeast India that has been practice from many generations. However, due to drastic change in climate condition many G.I.-certified products are in threat, leading to decrease in production, compromise in quality, and grading down the economic values. Northeast India is known for its diverse landscape and beautiful terrain for which each states has its own unique G.I.-tagged products, such as Muga Silk (Assam), Arunachal Orange, Naga Chilli, and Khasi Mandarin etc. The product's distinct qualities are derived from the region's climate, soil, and traditional methods of production which are only possible in those respective Geographical regions. However, with due course time rising

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temperatures, erratic rainfall, deforestation, and soil degradation threaten are affecting the sustainability.

The G.I. Act of 1999 provides protection for products with unique geographical origins, but it does not address the impact of climate change on their long-term sustainability. Furthermore, Indigenous communities, who are the traditional custodians of these products, face displacement, loss of livelihood, and reduced economic opportunities due to environmental changes. By addressing these gaps, G.I. laws can evolve into a more robust system that not only protects traditional products but also ensures the socio-economic well-being of Indigenous communities. Climate change is not just an environmental issue but also a legal and human rights challenge. Strengthening legal protections for Northeast India's G.I. products will help preserve its rich biodiversity, culture, and economic heritage.

Keywords: *Climate Change, Indigenous Rights, Northeast India, Traditional Knowledge, Legal Protection.*

1. INTRODUCTION

The Northeast region in India is filled with traditions, unique culture and plenty of wildlife, all of which have preserved by local people for many years. Some of the G.I. products in this region which include Muga Silk from Assam, Naga Mircha from Nagaland and Arunachal Orange from Arunachal Pradesh. All these goods are legally protected by India's Geographical Indications of Goods (Registration and Protection) Act, 1999 for being so important to the country's traditions. Because of this law, the benefits of these goods are given to those who produce them. Yet, because of climate change, traditional products and the lives of locals are now

meeting serious difficulties. Unusual weather conditions, forest depletion and natural disasters are putting many G.I. goods at risk of becoming of poor quality and less sustainable. Due to increase in business competition, fights over using land and inefficient enforcement, the issues caused by climate change worsen the condition of indigenous peoples and goods produced in those regions. At this point, there is a strong need for a joint legal system that helps solve problems related to the environment and indigenous peoples. Indigenous communities have always used sustainable farming, saved resources and traditional ecological understanding to cope with effects of climate change.

Laws in many countries do not always safeguard the land, traditions and resources of these people. While the United Nations Declaration on The Rights of Indigenous Peoples (UNDRIP) names the rights of indigenous groups to preserve their cultural traditions, these are not applied in practice in India. Climate adaptation and the safeguarding of indigenous rights could be better tackled through the G.I. laws. Decision-makers should include climate adaptation into G.I. defense at the same time as giving full consideration to the opinions of indigenous people during the process. Governments must also ensure their regulations are enforced to stop big businesses and other unapproved groups from exploiting G.I. goods. This wide legal approach to development and protection of the Northeast India encourages the preservation of culture and help the people survive the effects of climate change. Those who develop the system, though, need to include lawmakers, environmentalists, native leaders and all other professionals who are part of the system to make sure the system will be strong and just for all and the environment.

2. RESEARCH OBJECTIVES

1. To examine the impact of climate change on GI-protected products in Northeast India.
2. To analyse the effectiveness of current GI laws in safeguarding indigenous products against climate-induced vulnerabilities.
3. To identify policy gaps and legal challenges in integrating climate resilience into the GI framework.
4. To propose legal and policy recommendations that strengthen indigenous rights and climate adaptation strategies within the GI system.
5. To explore global best practices in GI protection and climate adaptation for potential application in the Indian context.

3. SIGNIFICANCE OF THE STUDY

Studies offers a detailed legal study of G.I. law and its inability to solve the climate change challenge, making suggestions on the areas that need amendment and brings out indigenous vulnerability in an effort towards ensuring their greater participation in making legal and policy decisions. Furthermore, the research supports environmentally sustainable productions for GI-tagged products, for economic and ecological long-lasting stability with comparison of legal insights by taking cues from international best practices.

4. RESEARCH METHODOLOGY

This study employs a doctrinal legal research approach, analyzing statutes, judicial decisions, and international treaties related to Geographical Indication (G.I.) law, climate change, and indigenous rights to understand the legal framework governing these issues. In addition to doctrinal analysis, the study incorporates empirical methods, reviewing policy reports, climate change impact studies, and field-based research from both governmental and non-governmental sources to assess the practical implications of existing laws and policies. A comparative legal analysis is also conducted, drawing insights from global best practices in regions such as the European Union and Latin America, where legal frameworks have successfully addressed similar challenges related to G.I. protection, climate resilience, and indigenous rights. Furthermore, the study takes an interdisciplinary approach, integrating perspectives from environmental science, anthropology, and legal studies to provide a comprehensive understanding of the interplay between intellectual property rights, environmental sustainability, and indigenous knowledge systems.

5. LITERATURE REVIEW

According to Clark and Kerr (2017), issues such as insufficient awareness of the law, high costs involved in certification and the use of geographical labels for profit are major problems faced while updating geographical indications. Climate change hurts G.I. products such as European wines and Assam tea by affecting their taste and quantity. It is important for the law to integrate strategies for dealing with climate change. Traditional owners of many plants and their land struggle to be recognized equally in G.I.

governance and to enjoy legal security for their land. United Nations Declaration on The Rights of Indigenous Peoples UNDRIP grants indigenous peoples' rights, but it is not effectively implemented. Authors suggest that governments introduce substantial laws about land ownership, sharing profits and representation to ensure equality.

To ensure G.I. protection from floods and hurricanes, adaptations to legal requirements are needed, suggests Rodriguez-Entrena & Arriaza (2013). Academics propose adaptive farming, including sustainable activities and guaranteeing the participation of local people in the creation of G.I. rules.

Datta, Sharma and Bora (2020) investigated, in the journal Geographical Indications in Horticulture: North East India Perspective, how GI law helps preserve Northeast India's indigenous horticulture practices related to climate change and the rights of indigenous groups. One of the points is that many people are not aware of GI, support for GI protection within institutions is thin and there is no effective marketing for Naga Mircha and Khasi Mandarin, making it difficult for them to benefit from GI. Since climate change endangers GI-tagged products, lawmakers should address this issue to ensure their long-term survival. It stresses the role of local communities, ensures applicable laws, applies IPR in preserving the environment and supports a start in the market and growth for rural areas.

The study looks at how Geographical Indication (G.I.) Law, climate change legislation and the rights of Indigenous people relate in the Northeast India region (Pongen, 2022). The concept argues that neoliberal approaches to nature market Indigenous lands and traditional systems as part of environment projects, carbon markets and biofuels globally. According to

the review, REDD+ and PES policies are presented as sustainable options; however, they often result in increased eviction from lands, poor treatment and further damage to the environment. The issue is explained by showing how new actions in Nagaland concerning climate change are adjusting the local land and political traditions. Covering political ecology and Indigenous studies, the research points out that conservation markets are flawed and suggests we back a campaign giving Indigenous peoples the right to their own land. In the study, it is shown that scholars should set policies based on Indigenous knowledge, not on European-style wildlife conservation, by using governmentality and accumulation by dispossession.

According to Dutfield (2017), native people can sustain their traditions and remain self-sufficient, thanks to G.I. law. Rangnekar (2004) states that even the G.I. law has challenges protecting traditional knowledge in response to newly emerging environmental problems. Not everyone agrees on how much G.I. helps in guarding indigenous knowledge. G.I. generally supports the economy, but Battacharya (2018) says it does not fully protect the ecological knowledge that is typically kept orally in societies.

Work by the Intergovernmental Panel on Climate Change (2019) reveals that climate changes can alter the supply of G.I. products such as tea and rice. According to Sharma (2020), monsoon changes in weather jeopardize the quality of Assam Tea and endanger its G.I. recognition. Several studies show that varying temperature and humidity have caused a reduction in the quality and amount of Muga Silk produced.

6. INTERNATIONAL & NATIONAL LEGAL FRAMEWORKS FOR INDIGENOUS RIGHTS AND CLIMATE ADAPTATION

Both the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and the Paris Agreement (2015) stress that indigenous groups should take part in efforts to control climate change. Still, it is questioned whether the Biological Diversity Act (2002) and the Geographical Indications Act (1999) are really effective measures to secure indigenous rights. According to experts, because Indian G.I. law lacks climate resilience rules, indigenous producers are easily affected by damage from climate change.

7. THE LEGAL FRAMEWORK FOR GEOGRAPHICAL INDICATIONS IN INDIA

The Geographical Indications of Goods (Registration and Protection) Act, 1999 looks after the protection of G.I. products in India. By Act, things from particular places that are known for their special qualities can be legally recognized and protected. Certain goods made in Northeast India such as Muga Silk from Assam, Naga Chilli from Nagaland, Arunachal Orange from Arunachal Pradesh and Kachai Lemon from Manipur, have obtained Geographical Indication titles (Geographical Indications Registry, Government of India, 2023). They are closely linked to the traditions and economy of different indigenous cultures. Even so, the law only covers registration and rules for legal safeguards and does not give specific attention to protecting the environment. Temperature increases, uneven rainfall and a fall in biodiversity due to climate change put these goods at risk. Authorities should find ways to reflect climate resilience matters when working on geographical information protection.

8. CLIMATE CHANGE AND ITS IMPACT ON G.I. PRODUCTS IN NORTHEAST INDIA

The area's ecosystems are gentle and its farming depends strongly on the weather, exposing the region to the risks of climate change. According to studies by the ICAR (2022), rising temperatures are reducing Muga Silk output in Assam and too much rainfall is damaging huge cardamom cultivation in Sikkim.[178] Similarly, variations in climate conditions are changing how Arunachal Orange and Kachai Lemon taste and how well they grow.

G.I. products are naturally linked to specific geographical conditions. Adjustments in temperature, soil fertility or rainfall can alter the distinctive factors for which G.I. goods are protected. The result is unexpected: laws protecting products linked to specific locations must adapt as climate change keeps altering them. WIPO (2021) suggests that for G.I. frameworks to function properly, they have to include environmental adaptations that will protect producers from risks brought by climate change.

9. INDIGENOUS RIGHTS AND CHALLENGES IN G.I. PROTECTION

In Northeast India, people from indigenous tribes have depended on their knowledge for sustainable farming over many years. However, experts on international law remark that indigenous participation in the G.I is still

[178] Ghanashyam Sharma and others, 'Declining Large-Cardamom Production Systems in the Sikkim Himalayas: Climate Change Impacts, Agroeconomic Potential, and Revival Strategies' (2016) 36(3) Mountain Research and Development 286 https://doi.org/10.1659/MRD-JOURNAL-D-14-00122.1 accessed 20 February 2025.

limited.[179]Most indigenous communities are unaware of the rights they have according to G.I. legislation, while many commercial companies often use traditional information for profit without offering adequate sharing of benefits.

In addition, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007) recognizes that FPIC is needed whenever intellectual property policies affect indigenous people. India is a member of UNDRIP, but has not fully included FPIC in its laws on geographic indications. The absence of clear indigenous policies means that G.I. protection cannot be properly protected or benefited by these groups.

10. CASE STUDY: MUGA SILK OF ASSAM AND CLIMATE CHALLENGES

The Sericulture Department of Assam has reported that Muga Silkworms are getting sick due to warmer weather which had lead to drop down productivity of Muga silk by approximately 30% in the past 10 years. Increase destruction of forest and land takeover have also made the primary host plant (Som tree) less useful for rearing of silk worm.[180]The registered Muga silk producer under GI Act have been granted with exclusive number of rights, but those rights does not give any assistance for facing climate

[179] Apurba K Baruah, Tribal Traditions and Crises of Governance in North East India, with Special Reference to Meghalaya (LSE Crisis States Research Centre Working Paper no 22, 2003) https://eprints.lse.ac.uk/28269/1/WP22AB.pdf accessed 16 February 2025.
[180] Thanks to Climate Change, Mizoram to Become a Major Producer of Muga Silk' Down to Earth (19 May 2017) https://www.downtoearth.org.in/climate-change/thanks-to-climate-change-mizoram-to-become-a-major-producer-of-muga-silk-56506 accessed 13 February 2025.

change. So, the weavers in Assam have appealed for including environment standards within GI system.[181] Kartik Neog, a scientist from Central Muga Eri Research and Training Institute (CMER&TI), while addressing IIT-Guwahati's Biodiverse 2018 conference, asserted that the Muga silkworm flourishes best at a temperature of 25-27°C with 75-85% humidity. Silkworm fatality rises at 15–33°C, resulting in a decrease in cocoon output and economic losses. The Indian Meteorological Department confirmed that Assam's mean temperature increases by 0.01°C every year from 1950 to 2010, with post-monsoon and winter warming, summer temperatures, especially June to September, can reach 30-40°C which makes silkworm rearing difficult and silkworm larvae become stressed, stop eating, and die at temperatures above 30°C stated by Manjita Basumatary, a silk farmer from the Bodoland Territorial Council.[182]

11. CHALLENGES

11.1. Inadequate Legal Protection:

Northeast area in India comprises of rich history of culture and interesting artifacts, but the area is facing lots of difficulties due to global climate change, instability of indigenous rights and most importantly weak Geographical Indication laws. The Geographical Indications of Goods (Registration and Protection) Act, 1999 consist of rules for the benefit of traditional producers, but due to complicated registration rules, insufficient

[181] Sahana Ghosh, 'Assam's Muga Silkworm Battles Climate Change' Mongabay India (6 February 2018) https://india.mongabay.com/2018/02/assams-muga-silkworm-battles-climate-change accessed 6 February 2025.
[182] Ibid.

enforcement and little community ownership it has become difficult for them to avail it. This problem has encouraged commercial companies to take advantage of their products and not pay them fairly. Moreover, climates change over the time and increase insects threat has lead to decrease in the production and low qualities of cardamom, Mizo chilli and Assam Muga silk. It has also been seen that indigenous rights are not adequately protected, since the government and business firms regularly have access to the G.I.s, leaving traditional producers with fewer economic gains. As indigenous peoples lack access to needed resources and are also affected by weak laws, biopiracy often results in taking and using their knowledge for commerce without permission. It is urgent to pass laws that improve G.I. which contain climate solutions, support indigenous property rights and ensure that these groups genuinely receive the income from their rich history and culture.

11.2. Lack of Indigenous Representation:

Since the region's traditional knowledge, local development and environment all depend on the involvement of indigenous peoples in G.I. documentation, climate change planning and indigenous rights guidelines, the lack of such participation has major consequences for Northeast India. Although the Geographical Indications of Goods (Registration and Protection) Act, 1999, was introduced, many G.I. places are owned by cooperatives, governmental bodies or enterprises, while indigenous people who have used and protected them for a long time rarely own them. They are being isolated which kept them away from enjoying real economic benefits and also directing their culture which has lead to more exploitation

and misuse by other organizations. Furthermore, strategies to control climate change omit indigenous ecological knowledge, which has fasten the destruction of biodiversity as a consequences product like Mizo Chilli, Arunachal Orange and Assam Muga Silk production are getting affected. In addition, laws about land and it resources which limit or stop the indigenous people from accessing traditional fields and forests, making it harder for them to collect geographical indication commodities. Until or unless a strong law is made which give guarantees to indigenous people, support their participation in policy making, it would be very difficult to address climate change, traditional goods, and enforce rights of indigenous communities. Laws need to be reviewed and quick change is needed to help indigenous groups obtain direct G.I. ownership, defend their product against climate change and receive legal protections against exploitation and secure sustainable development in Northeast India.

11.3. Climate-Induced Economic Vulnerability:

The threat of climate-based economic problems seriously affects Geographical Indication (G.I.) products, as many traditional items depends on stable weather for their growth and to stay special. Drastic change in temperatures, uncertain rainfall, degrading soil quality and increased insects infestation has put the certified G.I. product in danger, leading to smaller harvests, degrade quality and income loss to native farmers and craftsmen. Traditionally, Indigenous communities rely on cultural product tied to them to make their living, but they do not get aid from the G.I. system as nothing about climate resilience is in the statute. Due to climate change, product from natural biodiversity is less available and affecting economy fluctuate

which pushes many indigenous producers to choose unsustainable solutions or to immigrate. Besides, many international economic activity and fierce market competition have risked local communities, many a time middlemen and foreign businesses can take advantage of indigenous people by taking away their traditional wisdom without fairly compensating them. Situation get even more fragile due to lacking of enough climate-focused laws, funding or indigenous administration. So, economy conservation of Northeast India means to add climate adaption features to Geographical Indication laws, improving rules to help them withstand threats from climate change and subsidizing native producers.

11.4. Weak Enforcement Mechanisms:

Lack of enforcement of law for indigenous rights policies in Northeast India can lead to poor protection of traditional goods, cultural traditions and environmental sustainability, climate change. Despite the Geographical Indications of Goods (Registration and Protection) Act, 1999, no much enforcement has been seen which has allowed widespread misuse, counterfeiting of goods and unauthorized sales labelled with G.I. such as Arunachal Orange, Mizo Chilli and Assam Muga Silk. A lot of indigenous growers have little knowledge of the law and limited money to defend their rights, whereas the groups assigned to watch the market tend to turn a blind eye to offenses and offer little help with legal matters. Also, since climate legislation and regulations are poorly enforced, indigenous people are left unprotected from deforestation, land encroachment and resource exploitation, all of which harm G.I. goods. On top of that, indigenous communities have great difficulty accessing legal support when their

traditional knowledge is taken or when their environment is damaged. Because there are not enough laws, watchdog organizations or community controls, geographical indications do not work well and other parties can use native knowledge and resources without any limits. Better G.I. enforcement will require setting up new regulatory bodies, enforcing stricter punishments, adopting climate-friendly policies and granting indigenous people the power to protect their rights, traditions and economic well-being.

11.5. Limited Financial and Technological Support:

A lack of the necessary finances and technology is preventing successful enforcement of G.I. laws and the protection of indigenous rights in Northeast India, which made traditional producers to face challenges when competing todays world. Despite the Geographical Indications of Goods (Registration and Protection) Act, many indigenous communities are facing problem in accessing to finances, advanced infrastructure and technology required to improve and market G.I.-certified goods such as Arunachal Orange, Mizo Chilli and Assam Muga Silk. The costs of G.I. registration and enforcing trademarks are so high that many small producers can't effort to join, paving path for intermediaries and big businesses. Furthermore, change in climate has made traditional farming systems less effective, but the indigenous farmers and craftmen did not get any technology help to deal with climate change such as eco-friendly farming, drought-resistant crops or environmentally conscious processing, along with this no much support from government agencies, research money to test improve in production or digital marketing , it has become even harder for indigenous communities to increase benefits from their G.I. goods. To address this problem,

government must include financial aid for learning skills, use of advanced technology and help integrating their goods into the market, so that indigenous people thrive, continue their work and achieve economic success in Northeast India.

12. RECOMMENDATIONS

12.1 Climate-Responsive G.I. Protection:

G.I. goods protection in rural communities with unique cultural heritage is best done through G.I. preservation. Many products branded with the G.I. include Arunachal Orange, Assam Muga Silk and Large Cardamom are at great risk of decrease in production and degrade quality from rising temperatures, unpredictable rainfall, insects and poor soil. This crisis has resulted in less production for local growers, which is putting them under high financial risk. Even today, G.I. policy has not come up with any regulation related to climate change, so these settlements are vulnerable to climate-related changes without proper help or support. Without climate-themed regulations in geographical indication protection, farmers miss out on using easy-to-sustain farm methods, hardy crops and environmentally safe farming technology. Additionally, because of climate change and lowered resources, the traditional authority of indigenous groups over geographical indication items is threatened, allowing other parties to benefit from its knowledge. To guarantee that G.I. products continue to exist in the future, the legislation should cover climate adaptation steps like giving financial assistance, carrying out climate studies, providing eco-certification and offering more legal protection for native producers. A legal system fit for a changing climate would facilitate a response to environmental changes

while securing indigenous groups' ability to own and benefit from their heritage goods in Northeast India.

12.2 Enhancing Indigenous Involvement:

Involving indigenous communities into the law-making process to till its implementation relating to G.I. laws, climate policy, and indigenous rights assured support in all aspect such as economic, cultural, and environmental etc. Even after the enactment of the Geographical Indications of Goods (Registration and Protection) Act in 1999, the authentic traditional producers are usually not involved in decision-making as all the work relating to registration and protection is being taken care by those big cooperatives, government bodies or companies instead of the genuine producers resulting, the authentic producer are deprived economically and their long practiced cultural knowledge are being abused. Similarly, in climate policy and efforts to adapt it the indigenous people are being ignored though, their participation plays very important role in protecting the environment. Therefore, in serious notes the steps should be taken to solve the issues so that indigenous people who own the G.I. products, could take participate in protection of community matters and puts hands in helping climate response plans.

12.3 Legal Safeguards Against Biopiracy:

Protections against biopiracy also is matter of concern as to ensure the safeguarding of the Geographical Indication (G.I.) goods, indigenous knowledge and biodiversity in Northeast India, where the peoples of the region have kept their long traditional unique genetic resources and customs. Though there are enactment like Geographical Indications of Goods

(Registration and Protection) Act, 1999, the Biological Diversity Act, 2002 and the Nagoya Protocol, but, it don't always prevent indigenous communities from going through biopiracy. Inadequate surveillance and a lack of legal knowledge and its understanding among community members are the main causes of various G.I.-protected products such as Muga Silk, Arunachal Orange and Lakadong Turmeric to be threatened of biopiracy. For laws to be very strict, Government should enforce (PIC) Prior Informed Consent and (ABS)Access and Benefit Sharing more strictly, include indigenous communities in patent and G.I. reviews, and formulates an organised systems to prevent unapproved exploitation of biodiversity for commercial purposes. By enacting robust biopiracy protections law for G.I. laws, climate policies and intellectual property frameworks for the indigenous people of Northeast India would help them to conserve their history in better ways, financially sound and ensuring them from of safe use of their traditional knowledge.

12.4 Environmental Certification for G.I. Products:

To protect the future, as well as sellability and climate resistance, it is critical that G.I. items from Northeast India gain environmental certification, given their reliance on rich natural habitats. As climate change advances, Assam Muga Silk, Arunachal Orange and Large Cardamom are suffering, with their quality and production being affected by deforestation, reduced soil quality and new weather changes. At present, environmental sustainability isn't addressed in the G.I. laws and this makes it more difficult for indigenous farmers to sustain themselves and the planet. Constructing an environmental certification system that resembles organic or fair-trade labels would

confirm the use of environmentally friendly manufacturing, support sustainable farming and prevent the excessive use of natural resources. Additionally, certified products can get access to new markets, economic support and be protected from counterfeit items, so that only goods made sustainably and traditionally get G.I. recognition. In order to be very effective, environmental certification programs should use indigenous knowledge, encourage people in communities to take part and be supported by both government bodies and institutions. If G.I. rules are made environment-friendly, they would save biodiversity, minimize climate change and highlight Northeast India's famous traditional goods, adding to both indigenous people's well-being and their reputation.

12.5 Government Support for Climate-Resilient Agriculture:

Federal support for climate-friendly agriculture protects G.I. products, the ways people live in the Northeast and traditional farming, since climate change threatens agriculture in that region and products such as Arunachal Orange, Assam Muga Silk and Large Cardamom. Irregular rain, rising heat, weakening soil and new insects have lowered the quantity and quality of crops for farmers who depend on traditional practices that are influenced by weather. Even so, government policies on agriculture and G.I. laws have not provided the financial, scientific or infrastructure support indigenous farmers need to deal with such changes. For better resistance to climate change, the government should introduce subsidies, special research programs and changes in laws that encourage farming methods that resist drought, organic ways of farming and managing water resources sustainably. In addition, programs for learning new skills, financial aid and

opportunities to direct market products are needed so indigenous communities can cope with climate change without harming their G.I.-labeled goods. Boosting government action in climate-friendly farming will secure Northeast India's natural diversity, cultural tradition and a lasting ability to earn income and maintain its place in the global market for agriculture.

13. CONCLUSION

Issues relating to Geographical Indication (G.I.), climate change and Indigenous rights in Northeast India are both complex and very important. Many believe that G.I. law is important for shielding indigenous objects from harm, conserving their heritage and providing exclusive access to their market. The effects of climate change such as changes in temperature and rainfall, soil health and biological varieties, are a risk to G.I.-labeled products. Climate change could cause many regular farm and handicraft items that depend on specific climates to either vanish or diminish. This raises important questions about G.I. protection's ability to respond to rapid changes.

Because indigenous communities protect traditional knowledge and help with sustainability, their protection is vital to guarding G.I. These laws should be designed so that Indigenous people's rights to natural resources are respected and that businesses are helped to grow. When there is no shared policy that joins Indigenous rights with protecting geographical indication, Indigenous people face exploitation of their knowledge, a reduction in local resource control and inadequate monetary support. Because climate change causes them to lose their homes and important

resources, these people require stronger laws for their protection. Clear laws and policies are necessary to handle these problems. At the beginning, G.I. standards have to be adjusted to add climate resilience methods so unique objects do not lose their character when the environment changes. Next, Indigenous communities are expected to actively participate in registering G.I.s, making governance decisions and deciding on benefits. It is necessary to include environmental policy and G.I. laws in order to appreciate how cultural heritage, biodiversity and climate sustainability are linked. With G.I., Indigenous populations and their environment can continue to be protected by ways to adapt to climate change.

Ultimately, this means that policymakers have a big task in considering how IP, adaptation to climate and Indigenous rights should all be handled in Northeast India. Recognising the links among people, the environment and products in the law will help protect G.I.s and remain beneficial to Indigenous communities in the changing climate. Relying on sustainability, equity and resilience in law could create rules to preserve Indigenous knowledge and history in the face of global climate changes.

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X

CHANGING FOOD SAFETY STANDARDS IN THE ERA OF CLIMATE CHANGE UNDER THE SPS AGREEMENT

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ABSTRACT

The twenty-first century has seen a significant increase in worldwide trade in food and agricultural goods, with trade volumes doubling in the last decade. The establishment of the World Trade Organisation and the implementation of different trade agreements, particularly the Sanitary and Phytosanitary (SPS) Agreement, have played vital roles in promoting fair trade. This fair-trade framework has allowed numerous countries to promote their regional food items, including fruits, vegetables, marine seafood, and a range of other foods. As worldwide trade in locally farmed commodities grows, it becomes increasingly important to ensure their safety and quality. The SPS Agreement plays a substantial part in this process, safeguarding human, animal, and plant health by establishing standards that reduce the risks that arise from pests, illnesses, and food safety problems in imported goods.

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Despite being essential for fair trade and food safety, the SPS Agreement's complicated regulations may impede global trade. The problem has an indirect impact on the food trade by lowering quality, even though it doesn't directly address climate change. Climate change lowers the quality and competitiveness of food products worldwide by upsetting supply chains, changing growing conditions, and making people more susceptible to pests and diseases.

As importing nations continue to modify their food safety regulations, the interplay between climate change and local food items poses a significant obstacle to global trade. These items are either restricted to their regional locations or lose value on the international market as a result of changing climatic circumstances, which hinders the economic growth of exporting nations.

Keeping the above in view, this paper aims to examine the challenges posed by climate change in the context of international trade on food products, its impact on the changing food safety standards and the need for a more adaptable SPS Agreement

Keywords: *Climate Change, SPS Agreement, Global Trade, Trade Barriers, Food safety*

1. INTRODUCTION

We live in a unique environment in which climate influences agriculture, and agricultural products have a substantial effect on life. Every latitude and longitude on this planet offer a unique tale through its diverse agricultural

products. From Asia's vivid rice fields to the Mediterranean's lush olive groves, each region's distinct geology, climate, and cultural legacy have traditionally influenced what grows best where.[183] This complex tapestry of regional specialisation has affected global trade patterns for millennia, resulting in a diverse gamut of agricultural independence across nations. Food is vital and reflects the climate and topography of the area.[184] People who are born in diverse regions naturally adjust to the local cuisine, which shapes their habits, culture, and strength and helps them feel a strong connection to their surroundings. For example, rice becomes an indispensable food in Asia, while coastal dwellers thrive on meals high in seafood that is suitable for their climate. In a similar vein, people in colder climates eat a lot of meat and dairy products to survive the hard winters, whereas in tropical locations, fruits and root crops are more common because of their accessibility and nutritional value. Climate has a significant impact on culinary traditions as well as agriculture, highlighting the value of local agricultural goods. Trade between nations has further enhanced the strong relationships between the local agriculture and individuals, facilitating the global dissemination of varied culinary traditions. Following this, individuals all around the world increasingly include regional foods on their dinner tables, which promotes trade in these foods and a broader understanding of international flavours and cultures. However, climate change is already jeopardising this delicate equilibrium. With its far-

[183] Free Science, 'Food as a Reflection of Climate Geography and Traditions', <https://freescience.info/food-as-a-reflection-of-climate-geography-and-tradition/?utm_source=chatgpt.com>, accessed 25 February 25 2025.
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reaching effects, climate change is drastically altering traditional landscapes, upending food production, and posing a threat to the survival of centuries-old culinary traditions.

2. LITERATURE REVIEW

2.1. Climate Change and Food Systems[185]

The global food system is responsible for 19–29% of all greenhouse gas (GHG) emissions worldwide, making it a major contributor to climate change. From pre-production operations like the creation of fertilizer to post-production procedures like transportation, refrigeration, retail, and waste disposal, these emissions happen at every stage of the food chain. Although this varies greatly between countries, 80–86% of food-related emissions worldwide are attributable to agricultural production alone; in high-income countries, post-production stages are more important. With China being a major contributor, fertilizer manufacturing is a significant pre-production emission source that produced 284-575 megatonnes of carbon dioxide equivalent (MtCO2e) in 2007. Nitrous oxide from soils accounts for 38% of direct emissions in agricultural production, followed by methane from livestock digestion (32%), biomass burning (12%), rice production (11%), and manure management 7%. Indirect emissions are caused by changes in land cover, especially deforestation for agriculture, which is responsible for roughly 75% of the world's forest loss. While South/Southeast Asia and Latin America each produce over 3,000 MtCO2e

[185] Vermeulen SJ, Campbell BM and Ingram JS, 'Climate Change and Food Systems' (2012) 37 Annual Review of Environment and Resources 195.

annually, sub-Saharan Africa produces about 1,500 MtCO2e annually, of which roughly half is due to deforestation.

Food processing, particularly energy-intensive processes like corn wet milling, transportation, with its various modes of transportation having widely varying carbon footprints, refrigeration, which accounts for around 1% of global emissions but much higher in wealthy countries, retail operations, especially energy-intensive supermarkets, food preparation, both domestic and commercial, and food waste, which produces methane in landfills and wastes all the embedded emissions from production throu In turn, climate change affects food systems by affecting yields, food quality, safety, and delivery dependability.

2.2. National Oceanic and Atmospheric Administration[186]

The effects of climate change on prawn populations draw attention to a number of interrelated risks, with harmful algal blooms (HABs) emerging as a major worry. According to NOAA study, a variety of species, including toxic phytoplankton, cyanobacteria, benthic algae, and macroalgae, create different toxins that harm aquatic life, causing HABs to occur in freshwater, marine, and brackish habitats worldwide. By increasing nutrient loading, changing precipitation patterns, and warmer water temperatures, climate change exacerbates these risks by fostering the perfect environment for algal growth. Numerous climate-related stressors have been identified in the literature specifically for prawns: ocean acidification hinders shell

[186] National Ocean Service, *'Harmful Algal Blooms (HABs)'* <https://oceanservice.noaa.gov/hazards/hab/#:~:text=Harmful%20algal%20blooms%20(HABs)%20can,%2C%20benthic%20algae%2C%20and%20macroalgae>, accessed 4 April 2025.

formation; altered salinity patterns from shifting precipitation regimes push conditions beyond tolerance thresholds; decreased dissolved oxygen levels in warming waters create physiological stress; and rising water temperatures directly affect metabolism, growth, reproduction, and disease susceptibility. By exposing prawns to toxins like neurotoxins, hepatotoxins, and dermatoxins that build up in tissues and impair liver and nervous system function, HABs exacerbate these problems. They also deplete oxygen when blooms die and decompose, physically deteriorate habitats by suffocating benthic areas and reducing light penetration, disrupt shrimp-dependent food webs, and create an environment that is conducive to the growth of pathogenic bacteria by providing an abundance of nutrients. According to the research, these combined stressors pose a significant threat to both wild fisheries and aquaculture operations, with documented effects such as decreased growth rates, compromised immune function, increased mortality, altered migration patterns, and reproductive failures. While some management strategies exist, such as improved nutrient management, water quality monitoring systems, early warning mechanisms for HAB events, and temperature regulation in aquaculture facilities, the literature emphasizes the critical need for integrated approaches that take into account the complex interactions between climate change, HABs, and prawn physiology in order to protect this economically and ecologically important resource in a rapidly changing climate.

2.3. Food Safety and the Codex Alimentarius Commission[187]

The Codex Alimentarius Commission's institutional architecture is a special collaboration established under FAO and WHO auspices, with its dual paternity influencing its influence in global food standards. The commission's broad mandate and discretionary authority, guided by strategic planning procedures, offer flexibility and enable adaptation to emerging food safety challenges, even in the absence of restrictive legal mechanisms. The organizational structure of the Codex, which exemplifies a hierarchical approach to the development of food standards, consists of the Commission, executive committee, and subsidiary groups. The majority of substantive discussions occur at the committee level, with commission sessions mostly used to codify findings. The committee format, which covers both horizontal issues and specific commodities, allows for a detailed discussion of food safety concerns. Over time, participation and membership mechanisms have evolved, most notably during the EU's transition from observer to member. Among the stakeholders whose contributions are made possible by the observer status system are non-governmental organizations and international organizations. Fair consideration of policy concerns and technical advice during the standard-setting process is ensured by national standards and their domestic implementation.

[187] Thilo Rensmann, *'Food Safety and the Codex Alimentarius Commission, United Nations System'* (18 February_2025) <https://tudresden.de/gsw/phil/irget/copy2_of_ressourcen/dateien/jfoeffl7/dr_rensmann/un_system_text_no_4.pdf?lang=en>, accessed 18 February 2025.

2.4. SPS AGREEMENT

While the WTO's SPS (Sanitary and Phytosanitary) Agreement[188] is intended to preserve food safety and maintain fair trade practices, but it inadvertently exposes regionally conditioned goods to climate change risks. This is due to the agreement providing science-based standards and facts, which may not fully account for the fast-changing ecological circumstances impacting traditional producing regions.[189] As climate conditions grow increasingly irregular, regionally distinctive goods, which are typically protected by geographical indications or are strongly rooted in local agricultural traditions, confront enormous hurdles in maintaining consistent quality and safety profiles that conform to SPS agreements. The SPS Agreement's standardised approach, which places a higher priority on consistent safety measures across international markets, often ignores the unique challenges encountered by producers of foods that originate from a given geographical region, who must simultaneously meet international safety standards that were developed under different environmental assumptions.

3. Climate Change Impacts on International Agricultural Trade

As trade development achieves key milestones, climate plays a critical role in the development of agriculture, acting as both a driving factor for progress and a possible danger to sustainability. Desirable climatic conditions increase crop yields, improve product quality, and aid in agricultural

[188] WTO -SPS Agreement (Article 3), <WTO | Sanitary and Phytosanitary Measures - text of the agreement> accessed 26 February 2025.
[189] WTO -SPS Agreement (Article 3), <WTO | Sanitary and Phytosanitary Measures - text of the agreement> accessed 26 February 2025.

expansion. However, when climatic patterns change unexpectedly, this equilibrium is disrupted, providing significant barriers to global trade in local food. Escalating temperatures, erratic precipitation patterns, and an increase in the frequency of extreme weather patterns all have a detrimental effect on crop yields, product quality, and the ability of agricultural items to fulfill international standards. As international trade evolves, climate-induced disruptions endanger food security and economic stability, highlighting the critical need for adaptive tactics in agricultural trade regulations. Similarly, climatic conditions do not always occur naturally; some happen as a consequence of inescapable environmental changes, while others are caused by human activity and can be alleviated. One noteworthy example is the climate-induced disruptions impacting rice production and exports in Southeast Asia, where shifting weather patterns, rising temperatures, and major rainfall events have dramatically influenced yield stability and trade flow.[190]

The United Nations Food and Agricultural Organisation (FAO) has projected that in order to meet the increasing demand for rice, the world's agricultural sector will have to increase production by 5 million tonnes per year until 2050, posing an unprecedented challenge. This prediction is made in light of the growing population, shifting dietary behaviours, and changing regional demands for food security. This demand, however, creates a complicated paradox that entangles environmental sustainability with food

[190] Paul Teng and Jose Ma. Luis Montesclaros, 'Is Rice Production Becoming a Wicked Problem?' (S Rajaratnam School of International Studies, Oct. 2023), <https://www.rsis.edu.sg/wp-content/uploads/2023/10/NTS-Insight-IN-23-03-_Rice-production-as-a-wicked-problem_final.pdf> accessed 25 Feb. 2025.

security, leading to what experts refer to as a "wicked problem" in global agriculture policy and practice.

When addressing the increasing dangers to rice production posed by climate change-induced disruptions, the difficulties become more complex. Extreme weather events, notably floods and droughts, are becoming more often and severe, jeopardising the integrity of the global rice production system, particularly in Southern Asia. These climatic interruptions have an impact not just on present production levels, but also on the possibility of meeting predicted output increases. The impact is most severe in traditional rice-growing regions across Asia, where both short-term weather extremes and long-term climate change are disrupting circumstances that have been stable for centuries.[191] However, the link between rice production and climate change creates a cyclical problem that complicates viable remedies.

The act of growing rice production to satisfy food security goals inevitably results to the climate change challenges it faces.[192] Rice farming, particularly in traditional paddy systems, emits considerable amounts of methane owing to the anaerobic breakdown of organic materials in flooded fields. Furthermore, the use of nitrogen-based fertilisers in rice cultivation generates nitrous oxide emissions, another harmful greenhouse gas. Thus, the urge to expand output to fulfil food security demands may hasten the

[191] Paul Teng and Jose Ma. Luis Montesclaros, 'Is Rice Production Becoming a Wicked Problem?' (S Rajaratnam School of International Studies, Oct. 2023), <https://www.rsis.edu.sg/wp-content/uploads/2023/10/NTS-Insight-IN-23-03-_Rice-production-as-a-wicked-problem_final.pdf.> accessed 25 Feb. 2025.

[192] WTO -SPS Agreement (Article 3), <WTO | Sanitary and Phytosanitary Measures - text of the agreement> accessed 26 February 2025.

very consequences that endanger rice production stability.[193] This presents a cyclical dilemma in which climate change impacts rice production while rice growing techniques contribute to climate change. Breaking this loop necessitates a sophisticated technical strategy that both improves manufacturing efficiency and reduces environmental impact because both elements reinforce one another continually. In an era of climate change, this equilibrium is essential not just for the future of rice production but also for the more general objectives of sustainable agriculture and global food security.

4. Impact on Regional Products

To elaborate, the wealth of a country is greatly influenced by its locally produced food items, which are directly linked to its economic power. Every region has a different temperature and topography, which results in different crops that support local communities and play a major role in trade, employment, and rural development.[194] From the spice plantation of India[195] to the vineyards of the Mediterranean,[196] these agricultural items are important exports that improve economic stability and fortify international trade alliances. As countries seek for economic resilience, taking advantage

[193] WTO -SPS Agreement (Article 3), <WTO | Sanitary and Phytosanitary Measures - text of the agreement>, accessed 26 February 2025.
[194] United States Environmental Protection Agency, https://www.epa.gov/climateimpacts/climate-change-impacts-agriculture-and-food-supply, accessed 25 Feb. 2025.
[195] Times of India, "Chasing Spices, Coffee and Aromas in India" <https://timesofindia.indiatimes.com/travel/things-to-do/chasing-spices-coffee-and-aromas-in-india/articleshow/64202295.cms> accessed 25 Feb. 2025.
[196] Dalu, J.D., Baldi, M., Dalla Marta, A. *et al.*, "Mediterranean climate patterns and wine quality in North and Central Italy," (2013) 57 (729) Int. J Biometeorol Vol. 57 <file:///C:/Users/nanda/Downloads/s00484-012-0600-4.pdf>.

the potential of locally developed products via innovation, sustainable practices, and strategic trade policies may open up new avenues for development and long-term success.

Regionally conditioned goods exhibit a unique convergence of location, climate, and centuries-old farming traditions. These products, often protected by geographical indications (GIs) or similar designations, derive their distinctive qualities from specific environmental conditions within their traditional growing regions. Their authenticity and market value are intrinsically linked to their terroir, which encompasses the natural environment, including soil composition, topography, climate, and biodiversity. This connection to local environmental conditions enhances their uniqueness and economic significance, it also makes them highly vulnerable to climate change.

As international trade promotes fair exchange among nations, extreme climate events such as droughts, heat waves, and heavy rainfall pose serious threats to the supply chains of key agricultural commodities. The vulnerability of regionally conditioned products arises from their dependence on stable environmental conditions, which, if disrupted, can lead to significant economic consequences.

5. Challenges to trade

There are two primary challenges that threaten fair trade in this context. First, natural climatic factors such as severe droughts, erratic precipitation, and soil degradation can directly affect product quality, making them less competitive in global markets and jeopardizing international trade. Second, geographical and regulatory barriers might further limit trade under the

World Trade Organization's (WTO) Sanitary and Phytosanitary (SPS) guidelines. This agreement, which oversees food safety and the health of humans, animals, and plants, permits importing countries to apply stricter safety and quality criteria based on scientific data. If climate change affects the quality of export commodities, those items may fail to fulfill the needed SPS Standards, resulting in trade restrictions and economic downturns for exporting countries. Since local goods are closely linked to their natural surroundings, they are especially susceptible to the effects of climate change. An excellent illustration of this is Darjeeling tea, which is well-known for its unique flavour and widespread demand.

6. Case of Darjeeling Tea

The instance of Darjeeling tea from India exemplifies how climate change poses a significant danger to locally conditioned products. Darjeeling tea, known internationally for its unique muscatel flavour and flowery scent, is grown solely in the Himalayan foothills, at heights ranging from 600 to 2,000 meters.[197] The region has an average annual rainfall of 309 cm, providing good conditions for tea growth. [198] Due to its unique terroir, Darjeeling tea cannot be grown or manufactured anywhere else in the world[199], making it a highly sought-after premium tea, often referred to as the "Champagne of Teas."[200]

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[197] Tea Board of India, *"Darjeeling Tea"* <https://www.teaboard.gov.in/TEABOARDCSM/NQ==> accessed 25 Feb. 2025.
[198] Tea Board of India, *"Darjeeling Tea"* <https://www.teaboard.gov.in/TEABOARDCSM/NQ==> accessed 25 Feb. 2025.
[199] Tea Board of India, *"Darjeeling Tea"* <https://www.teaboard.gov.in/TEABOARDCSM/NQ==> accessed 25 Feb. 2025..
[200] Goodricktea, https://goodricketea.in/blogs/home/here-is-why-darjeeling-tea-is-called-champagne-of-

However, in recent years, shifting climatic conditions have significantly disrupted traditional agricultural patterns, and Darjeeling's tea industry has been no exception. Rising temperatures, erratic rainfall, and increased humidity fluctuations have directly impacted both the yield and quality of Darjeeling tea. The delicate balance of temperature, humidity, and seasonal rainfall are the key factors in producing the tea's signature flavor has become increasingly unstable due to climate change, threatening the long-standing tea-growing heritage of the region.[201]

Reports indicate that climate change has led to a rise in pests and plant diseases, further deteriorating tea quality and productivity. Increasing temperatures and heightened ambient CO_2 concentrations, combined with extreme rainfall events, have had detrimental effects on the chemical composition of tea leaves, altering their distinct taste and aroma.[202] Through the rise in CO_2, it can reduce the nutritional value of produce.[203] It mainly reduces the protein and essential minerals in most plant species.[204] The

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teas#:~:text=Even%20today%2C%20Darjeeling%20tea%20is,as%20the%20champagne%20of%20teas, accessed 25 Feb. 2025.

[201] Netrananda Sahu, Rajiv Nayan, Arpita Panda, Ayush Varun, Ravi Kesharwani, Pritiranjan Das, Anil Kumar, Suraj Kumar Mallick, Martand Mani Mishra, Atul Saini, Sumat Prakash Aggarwal and Sridhara Nayak, "Impact of Changes in Rainfall and Temperature on Production of Darjeeling Tea in India," (MDPI, 24 Dec. 2024), <https://www.mdpi.com/2073-4433/16/1/1#B9-atmosphere-16-00001> accessed 25 Feb. 2025.

[202] Times of India, *"Chasing Spices, Coffee and Aromas in India"* <https://timesofindia.indiatimes.com/travel/things-to-do/chasing-spices-coffee-and-aromas-in-india/articleshow/64202295.cms> accessed 25 Feb. 2025.

[203] United States Environmental Protection Agency, *"Climate Impacts on Agriculture and Food Supply"* <https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply> accessed 25 Feb. 2025).

[204] United States Environmental Protection Agency, *"Climate Impacts on Agriculture and Food Supply"* <https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply> accessed 25 Feb. 2025).

global temperature has already risen by an average of 0.74°C over the last 100 years and is projected to increase by at least 3°C within this century, signaling an impending crisis for Darjeeling tea production.[205] These climatic shifts have created a complex challenge for tea growers, as the green leaf yield of tea plants has shown a significant correlation with total rainfall and humidity levels. Any imbalance in these environmental factors directly impacts both production volume and the market value of Darjeeling tea.[206] With climate projections indicating further instability, urgent interventions are needed to adapt and mitigate the effects of climate change on this globally. In this case study, it illustrates how climate change can threaten not only the volume but also the very characteristics that make regional products unique and valuable in international markets. The experience of Darjeeling tea serves as a warning for other regional products facing similar challenges and highlights the urgent need for adaptive strategies to preserve these cultural and economic assets.

7. Marine products

Just as climate change has disrupted tea cultivation in Darjeeling, it has also profoundly impacted marine fisheries, altering ocean temperatures, disrupting ecosystems, and threatening the livelihoods of coastal communities that depend on fishing. India has established itself as a

[205] Times of India, "Chasing Spices, Coffee and Aromas in India" <https://timesofindia.indiatimes.com/travel/things-to-do/chasing-spices-coffee-and-aromas-in-india/articleshow/64202295.cms> accessed 25 Feb. 2025.
[206] Times of India, "Chasing Spices, Coffee and Aromas in India" <https://timesofindia.indiatimes.com/travel/things-to-do/chasing-spices-coffee-and-aromas-in-india/articleshow/64202295.cms> accessed 25 Feb. 2025.

significant player in the global seafood market.[207] In the year 2022-23 fiscal year, the country exports marine products worth approximately USD 8.09 billion supporting the lives of over 16 million fisheries and fish farmers, predominantly from coastal communities with limited alternative economic opportunities.[208] The vulnerability of this sector to climate change stems from both its economic importance and the ecological sensitivity of India's coastal ecosystems. The Arabian Sea and the Bay of Bengal, which border India's western and eastern coasts respectively, are experiencing rapid changes in temperature regimes, current patterns, and chemical composition. These oceanic changes directly affect the distribution, abundance, and health of commercially vulnerable marine species upon which coastal communities depend.

Climate change has profoundly impacted India's marine ecosystems, disrupting key fisheries and export industries. Rising sea surface temperatures, especially in the Arabian Sea, have altered the breeding cycles and migration patterns of commercially valuable species.[209] Increased

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[207] Times of Oman, *"India Emerges a Strong Player in the Global Seafood Exports"* <https://timesofoman.com/article/147515-india-emerges-a-strong-player-in-the-global-seafood-exports> accessed 25 Feb. 2025.

[208] The Marine Products Export Development Authority, *"India's Seafood Exports Flying Highest to USD 8.09 Billion in FY 2022-23"* <https://mpeda.gov.in/wp-content/uploads/2023/06/Press_Note_MPEDA_Export-Performance_2022-23_June-2023.pdf> accessed 25 Feb. 2025.

[209] Times of India, *"Marine Life Faces Threat as Arabian Sea Heats Up, Intensifies Cyclones, Says NIO"* <https://timesofindia.indiatimes.com/city/goa/marine-life-faces-threat-as-arabian-sea-heats-up-intensifies-cyclones-says-nio/articleshow/105337817.cms> accessed 25 Feb. 2025.

temperature and salinity levels have further destabilized marine environments, placing stress on ecosystems.[210]

The influx of warmer water has disrupted the delicate balance of marine life, leading to thermal stress on coral reefs and widespread coral bleaching.[211] Ocean acidification has also reduced calcification in mollusks, resulting in thinner shells and lower meat yields in clams, mussels, and oysters, ultimately affecting their market value.[212] These quality concerns have led to increased inspection rates and higher rejection rates in major export markets.

India's shrimp exports, which account for nearly 70% of the country's marine export value, have been particularly affected. Warming coastal waters have created favorable conditions for bacterial and viral infections, such as the White Spot Syndrome Virus (WSSV) and Early Mortality Syndrome (EMS).[213] In response, shrimp farmers have increased antibiotic

[210] Times of India, *"Marine Life Faces Threat as Arabian Sea Heats Up, Intensifies Cyclones, Says NIO"* <https://timesofindia.indiatimes.com/city/goa/marine-life-faces-threat-as-arabian-sea-heats-up-intensifies-cyclones-says-nio/articleshow/105337817.cms> accessed 25 Feb. 2025.
[211] Times of Oman, *"India Emerges a Strong Player in the Global Seafood Exports"* <https://timesofoman.com/article/147515-india-emerges-a-strong-player-in-the-global-seafood-exports> accessed 25 Feb. 2025.
[212] International Atomic Energy Agency, https://www.iaea.org/newscenter/news/jeopardy-at-sea-what-atoms-in-clams-tell-us-about-ocean-acidification, (Last Visited Feb. 25, 2025).
[213] Aqua Culture -Asia Pacific, *"India's farmed shrimp sector in 2020: A White Paper - Aqua Culture Asia Pacific"*, <https://aquaasiapac.com/2021/07/31/indias-farmed-shrimp-sector-in-2020-a-white-paper/> accessed 25 Feb. 2025).

use, leading to stricter scrutiny and rising rejection rates, especially in EU markets.[214]

Climate change is radically changing locally conditioned commodities by disrupting established manufacturing techniques, lowering quality, and jeopardising market stability. Agriculture and tourism, which rely on scientific climatic conditions, are facing more unpredictability as temperatures vary and weather patterns change. These disturbances endanger not just livelihoods, but also the cultural and geographical uniqueness of these products. As a result, adaptive actions at the local, national, and global levels are critical to the sustainability of these businesses. However, it is also necessary to critically explore the limitations and constraints associated with estimating climate impacts in order to design more comprehensive and effective long-term resilience plans.

8. LIMITATIONS

Climate change is frequently identified as a key cause of diminishing quality in regionally conditioned commodities; however, this viewpoint requires careful evaluation. The current study indicates that climate change is not the only important element influencing product quality. Aside from climate-related variables, a variety of additional factors contribute to product quality variations, such as farming methods, market pressures, changing customer preferences, and regulatory changes. The observed quality variations in regional goods are most likely caused by a complex interaction of several

[214] Aqua Culture -Asia Pacific, *"India's farmed shrimp sector in 2020: A White Paper - Aqua Culture Asia Pacific"*, <https://aquaasiapac.com/2021/07/31/indias-farmed-shrimp-sector-in-2020-a-white-paper/> accessed 25 Feb. 2025).

causes, making a single attribution to climate change scientifically challenging. This oversimplification risks diverting resources and governmental attention away from other possibly major contributory elements that are more easily addressed.

This argument emphasises the significance of scientific rigour when considering climate change implications, as well as the diversity of factors influencing regional goods.

As the natural quality of Darjeeling tea deteriorates owing to shifting precipitation patterns and temperature shifts, tea producers have become more reliant on fertilisers and pesticides to sustain production. However, the widespread use of agrochemicals has had serious implications, particularly for female workers who are constantly exposed to harmful compounds. Prolonged exposure to these chemicals has raised major health concerns among plantation workers.[215] This dependency on chemical inputs coincides with a shift in global markets towards more organic and sustainable products. Several countries have already rejected Darjeeling tea consignments due to excessive pesticide residues, raising concerns under the WTO-SPS Agreement. The inability to meet international safety standards not only undermines the tea's marketability but also threatens its status under fair trade agreements, leading to reduced exports and economic losses for the industry.

[215] Purnima Sah, *"Why Climate Impact on Tea Yield is Making Women Workers Sick, Behan Box",* (Behan Box 30 April 2022), <https://behanbox.com/2022/04/30/why-climate-impact-on-tea-yield-is-making-women-workers-sick/> accessed 25 Feb. 2025.

Similarly, marine fisheries demonstrate how climate change interacts with numerous other stressors. Rising ocean temperature and acidification certainly affect fish populations and migration patterns. However, the quality and availability of regional seafood products are equally impacted by overfishing, destructive fishing practices such as ghost fishing[216], pollution from land-based sources, and inadequate fisheries management. In many regions, economic pressures and regulatory failures have more immediate and profound effects on fish stocks than gradual climate changes. A comprehensive approach must address these multiple stressors simultaneously rather than focusing exclusively on climate adaptation measures.

Despite the widespread attribution of declining regional product quality to climate change, the real challenge lies in the unintended consequences of response strategies. Efforts to counteract climate impacts often involve unregulated alternatives that, rather than resolving the issue, exacerbate environmental degradation. This, in turn, intensifies climate change, creating a self-reinforcing cycle that becomes increasingly difficult to break. The ripple effects of this cycle extend beyond agriculture and marine industries, influencing broader economic, environmental, and public health dynamics. Trade and investment also suffer as quality concerns and regulatory restrictions limit market access. With diminishing opportunities for sustainable economic development, vulnerable communities face escalating hardships, as both traditional practices and adaptive solutions

[216] Food and Agriculture Organization, *"Fisheries Impact on the Ecosystem"*, <https://www.fao.org/4/y4773e/y4773e05.htm> accessed 25 Feb. 2025.

present new challenges. Addressing this ongoing cycle requires a holistic approach that considers the intricate interconnections between climate change, production methods, and broader socio-economic factors, rather than relying on short-term, narrowly focused interventions.

9. CONCLUSION

Climate change poses a significant threat to food security at global, regional, and local levels by disrupting availability, restricting access, and diminishing food quality. The increasing intensity and frequency of extreme weather events endanger food supply chains, leading to volatile price fluctuations that are likely to become more prevalent. Additionally, rising temperatures accelerate food spoilage and increase contamination risks, further compounding food security challenges. Tackling these issues requires a forward-thinking and holistic strategy that promotes sustainable farming practices, invests in technological innovations, and reinforces regulatory frameworks for environmental protection. Building a resilient and sustainable food system demands a commitment to innovation, international collaboration, and ecological stewardship. By integrating climate-smart agriculture, leveraging advanced technologies, and implementing robust environmental policies, we can protect regional food products from climate change while securing long-term food stability. The choices we make today will shape a more sustainable, just, and thriving food future for generations to come.

10. SUGGESTIONS

Addressing the impact of climate change on regionally conditioned goods requires a comprehensive and adaptive approach that extends beyond

reactive measures. Climate change is a major concern for economics, ecologists, and those concerned in production, trade, and export. However, simply attributing these issues to climate change while rejecting current technology breakthroughs owing to probable negative consequences would be unproductive. Instead, it is critical to recognise the complex relationship between modern agriculture and climate change, since its effects are frequently more detrimental than helpful. As a result, establishing effective adaptation methods and avoiding negative impacts in agriculture has become a top concern for sustainability and resilience.

A multidimensional strategy that incorporates sustainable agriculture techniques, biodiversity protection, and novel food system initiatives is required. Crop rotation, decreased chemical inputs, and soil conservation are all regenerative agriculture strategies that can help preserve soil health and reduce carbon emissions while also assuring future food security. Protecting natural landscapes, such as forests, wetlands, and peatlands, is critical because these ecosystems serve as carbon sinks and promote biodiversity. The loss of such landscapes for agricultural growth not only increases greenhouse gas emissions, but also upsets the ecological balance required for long-term food supply.

Improving local food production and cyclical food systems can minimise reliance on lengthy supply chains, making fresh, seasonal, and locally sourced food more available while cutting transportation emissions. Controlled Environment Agriculture (CEA), such as greenhouses and vertical farming, allows for year-round agriculture, limiting exposure to harsh weather occurrences. Furthermore, boosting alternative protein

sources, such as plant-based and insect-based proteins, can dramatically reduce emissions from animal production, which now accounts for around 14.5% of total anthropogenic greenhouse gas emissions.

Addressing the negative environmental impact of food packaging is also important for decreasing waste and pollution. Sustainable alternatives, such as compostable and biodegradable materials, should be used instead of conventional plastics, which contribute to landfill buildup and environmental damage. Strengthening regulatory measures to avoid deforestation-linked agriculture and encouraging responsible land use can boost resilience to climate change. By combining these techniques, the food system may reduce its environmental impact while preserving the long-term viability and security of regional food supplies.

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United States Environmental Protection Agency, 'Climate Impacts on Agriculture and Food Supply' https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply accessed 25 February 2025.

Vermeulen SJ, Campbell BM and Ingram JS, *'Climate Change and Food Systems'* (2012) 37 *Annual Review of Environment and Resources* 195.

WTO, 'Sanitary and Phytosanitary Measures - Text of the Agreement (Article 3)' https://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm accessed 26 February 2025.

XI

LEGAL APPROACHES TO PROTECTING CLIMATE MIGRANTS: EXAMINING THE EMERGING LEGAL ISSUES SURROUNDING CLIMATE-INDUCED DISPLACEMENT AND MIGRATION, AND PROPOSING LEGAL PROTECTIONS FOR CLIMATE MIGRANTS

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ABSTRACT

The growing impacts of climate change are causing displacement of millions globally, leading to rise in number of climate migrants whose legal status is not recognized by any law. This article explores the concept of climate-induced displacement, and critically examines the insufficient international and national legal frameworks in addressing the needs of those affected. While climate migrants are recognized as a distinct and vulnerable group globally, yet the current legal protections for them remain fragmented and inadequate. The article explores these legal and policy gaps, including the exclusion of climate-related displacement from the 1951 Refugee Convention, to address the cross-border displacement and the compounded vulnerabilities arising from socio-economic inequalities especially in the region of South Asia. Particularly, Indian states like West

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Bengal and Assam, experience growing climate migration from Bangladesh due to sea-level rise, riverine flooding, and salinization of arable land. The article further advocates for the development of comprehensive legal protections at both international and domestic levels, including the recognition of climate migrants in international law, the adoption of existing legal instruments, and the formulation of human rights-based national policies. Finally, it underscores the need for a coordinated global response to ensure the dignity, rights, and protection of climate migrants.

Keywords: *1951 Refugee Convention, Climate-induced displacement, Climate migrants, India, South Asia.*

1. INTRODUCTION

Climate change is one of the leading causes of human displacements globally, disrupting the lives and livelihoods of millions.[217] Its impacts spread across ecosystems, economies, social groups.[218] Over the past decades, the unpredictable weather patterns, rising sea levels, severe droughts, and intensifying storms have accelerated environmental degradation.[219] These events are highly responsible for the increase in climate-induced displacements.[220] Unlike traditional forms of migration,

[217] Intergovernmental Panel on Climate Change, *Climate Change 2023: Synthesis Report* (IPCC 2023).
[218] United Nations Environment Programme, *Disasters and Conflicts: Climate Change* (UNEP, 2022) https://www.unep.org accessed 26 May 2025.
[219] World Bank, *Groundswell: Preparing for Internal Climate Migration* (World Bank 2018).
[220] Jane McAdam, *Climate Change, Forced Migration, and International Law* (Oxford University Press 2012).

which are often triggered by economic or political reasons, climate migration driven by sudden environmental disasters and gradually occurring climate change.[221] While, natural calamities like floods, cyclones, and wildfires can force entire communities to flee immediately, the slowly occurring process such as desertification, coastal submergence, soil salinity, and melting glaciers make regions uninhabitable over time.[222] Especially for those depend on agriculture, fishing, or other natural resource-based livelihoods, leaving their homes becomes a matter of survival.[223]

South Asia is particularly vulnerable due to frequent occurrences of such events, with India facing most challenging problems in the region.[224] High population density, regional inequalities, and monsoon dependent agriculture, intensify the adverse effects of climate change. Rural populations, are the most vulnerable and the least equipped to adapt to such occurrences. As the environment crisis intensifies cross border migration becomes a coping mechanism.[225] This rapidly growing climate-related displacement requires urgent, and multilateral responses. Policies which focus not just on environmental protection and climate adaptation but also ensure the rights and dignity of the displaced individuals.[226] Building

[221] International Organization for Migration (IOM), *Migration, Environment and Climate Change: Policy Brief Series* (Issue 1, IOM 2014).
[222] United Nations High Commissioner for Refugees, *Climate Change and Disaster Displacement in the Global Compact on Refugees* (UNHCR 2021).
[223] Amrita Ghatak, 'Climate-Induced Displacement and the Right to Livelihood in India' (2020) 45 EPW 23.
[224] Aditya Ghosh and Anuradha Mukherji, 'Climate Change-Induced Displacement: Case Study of Assam, India' (2016) 18 EUA 45.
[225] IDMC, *Disaster Displacement in Asia and the Pacific: A Snapshot* (Internal Displacement Monitoring Centre 2021).
[226] Sumudu Atapattu, 'Climate Change, Human Rights, and Forced Migration: Implications for International Law' (2018) 27 WILJ 607.

resilient infrastructure, sustainable livelihoods, and inclusive governance is crucial to support vulnerable communities.[227]

This article explores legal framework for protecting climate migrants internationally as well as domestically from an Indian perspective. It examines various drivers of displacement viz. environmental, economic, and demographic factors. It reviews regional cooperations and initiatives particularly in South Asian region. It encompasses global case studies; and offers recommendations for comprehensive legal reforms. Despite significant advances in environmental and refugee law, the current legal system fails to address the pressing needs of climate migrants. A coordinated global response is the need of the hour, to protect the rights and dignity of those forced to migrate due to environmental factors including climate change.

2. LITERATURE REVIEW

Architesh Panda, in his paper *Climate-Induced Migration from Bangladesh to India: Issues and Challenges,*[228] examines the rise in climate induced displacements in the region of South Asia, particularly from Bangladesh to India. He argues that climate migration is not only an environmental issue but also a socio-political and economic challenge lacking adequate legal protections. The author introduces the concept of "nested vulnerability," highlighting that decisions to migrate are highly influenced by

[227] UNDP India, *Climate Action for Sustainable Development* (UNDP 2022) https://www.undp.org/india accessed on 26 May 20205.

[228] Architesh Panda, 'Climate Induced Migration from Bangladesh to India: Issues and Challenges' (2019) SSRN Electronic Journal https://ssrn.com/abstract=2186397 accessed 26 February 2025.

interconnected vulnerabilities. His study underlines that without proper institutional frameworks for climate migrants, their movement may pose persistent challenges for both origin and destination countries.

Panda explores the historical background of environment induced migrations and the growing debate over the term "climate refugees." He gives reference of scholars like Norman Myers (1997), who claims that by 2050 over 200 million people will be displaced because of climate change, exceeding the existing population of refugees. However, scholars like Castles (2002), raise question on such predictions, arguing that there exist various other factors which induce migrations other than climate change, such as economic conditions and political instability. He further explores the migration trends from Bangladesh to India, highlighting that sea levels rise, increased cyclones, and land erosion have already forced thousands to migrate. He emphasizes that India, being the immediate and primary destination, faces socio-political tensions due to unregulated and undocumented cross-border movements.

Jane McAdam, in her book *Climate Change, Forced Migration, and International Law,*[229] analyzes the legal drawbacks in countering the climate-induced displacement. She argues that current international refugee law, particularly the 1951 Refugee Convention, does not extend protection to individuals displaced due to climate change. This exclusion further worsens the legal position of climate migrants, as they are mostly treated as economic migrants rather than refugees. The author while examining legal provisions in different jurisdictions, emphasizes on mechanisms such as

[229] McAdam (n 6).

Temporary Protected Status (TPS) in the United States, which grants temporary relief to individuals from disaster-affected regions.

McAdam also explores regional legal frameworks, such as the European Union's Temporary Protection Directive, which could in theory be extended to climate migrants but has not been put to use in that direction. She discusses alternative solutions, such as the human rights-based approaches and framing of new treaties. The author makes reference to the Nansen Initiative, which seeks to develop international guidelines for addressing climate displacement, but also highlighting that its recommendations are non-binding. The author finally stresses upon the need for stronger legal mechanism and global recognition of climate migrants with proactive adaptation of policies to prevent future displacement.

Pegu and Dutta, in their article *Disappearing Earth: The Impact of Environment-Induced Migration on India and the World*,[230] examine how already marginalized communities are disproportionately affected by climate change. They argue climate migration is occurring both internally and across borders, with India facing significant influx of migrants from neighboring countries particularly Bangladesh. The study highlights the nexus between socio-economic inequalities and environmental degradation in shaping migration patterns, noting that the most vulnerable are those who live in rural areas. India's insufficient policies, which fail to recognize climate migration as a distinct category of displacement is also discussed. The authors argue for policy reforms, underscores the need for integrating

[230] Kumar Pegu and Mitul Dutta, 'Disappearing Earth: The Impact of Environment-Induced Migration on India and the World' (2019) 49 EPL 63.

climate migration into national development plans and strengthening legal protections for displaced populations.

3. CORE ARGUMENT

3.1 Definitions and Scope

Migration generally refers to the movement of people from one place to another, usually involving a change in their usual place of residence. However, displacement refers to a specific type of movement, which includes coercion that forces people to abandon their habitual homes and move out. When environmental factors like climate change are the primary cause for such movements the phenomenon is described as climate-induced displacement or climate migration.[231] Despite its growing recognition, there exists no universally agreed definition of climate migrants which creates legal challenges for these migrating communities.

The International Organization for Migration (IOM) provides a working definition of climate migration as "the movement of individuals or groups who, primarily due to sudden or gradual environmental changes caused by climate change, are compelled or choose to leave their usual place of residence, temporarily or permanently, within a country or across borders."[232] The difference between voluntary migration and forced

[231] United Nations High Commissioner for Refugees (UNHCR), *Climate Change, Disaster and Displacement in the Context of the UNFCCC: Submission by the United Nations High Commissioner for Refugees* (UNHCR, 2016) https://www.unhcr.org/protection/environment/5783553e4/climate-change-disaster-displacement-context-unfccc-submission-unhcr.html accessed 26 May 2025.

[232] International Organization for Migration, 'Migration and Climate Change' (IOM Migration Research Series No 31, 2008.

displacement is often blurred when linked to climate change. While some decide to move in anticipation of future environmental risks, others relocate unexpectedly when their living conditions deteriorate beyond viability. For instance, sudden natural disasters like floods or cyclones often cause temporary displacement, whereas slow-onset phenomena such as sea level rise or desertification can lead to permanent migration.[233] Considering these dynamics the term "climate-induced displacement" broadly encompasses all movements driven by environmental changes, while recognizing the influence of overlapping factors.[234]

3.2 Causes of Climate-Induced Migrations

Climate-induced migration is triggered by a range of environmental and socio-economic factors. Globally, rising sea levels, extreme weather patterns, severe droughts, flooding and water scarcity are displacing many from their homes both internally and across the border. Coastal regions experience increased flooding and erosion, while droughts disrupt the agriculture in arid zones, forcing people to move in search of food and water. In the absence of effective adaptation strategies, climate migration is expected to rise significantly in the coming decades.[235]

In India, climate-induced migration is caused due to multiple reasons including environmental, economic, demographic factors. Coastal areas like the Sundarbans are under severe threat due to the rising sea levels,

[233] McAdam (n 6).
[234] Kristy McKinnon, 'The Complexities of Climate-Induced Displacement' (2021) 12 EMR 45.

[235] World Bank, *Groundswell: Preparing for Internal Climate Migration* (World Bank 2018).

unpredictable weather patterns, and environmental degradation, all of which affects agriculture and fishing activities that sustain local communities in the region. In such circumstances migration is regarded as the only few viable options for survival.[236] The lack of government support exacerbates the existing economic vulnerabilities in such areas. India being an agricultural economy depends on cultivation of crops and fisheries in coastal regions. When such economy is disrupted by climate change, whether through reduced crop yields, water scarcity, or declining fish stocks the people are forced to look for alternative sources of income by relocating themselves to stable regions.[237]

Demographic factors like increasing population and poverty pushes people to move to urban areas for better opportunities in turn overcrowding cities with limited infrastructure, which further results in poor living conditions.[238] Another crucial factor is cross-border migration. Bangladesh's sensitive ecology and frequency of natural disasters in the region expose its people to increased climate risks, forcing them to migrate across the border. The lack of legal protection, expose these migrants to exploitation and insecurity[239] and they get stuck in continuous cycle of displacement and vulnerability.[240]

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[236] ActionAid, 'Addressing Climate Change-Induced Displacement and Migration in Bangladesh' (2020).

[237] Susmita Dasgupta et al, *'Sea-Level Rise and Storm Surges: A Comparative Analysis of Impacts in Developing Countries'* (Policy Research Working Paper No 4901, World Bank 2009).

[238] S Chella Rajan, *'Blue Alert: Climate Migrants in South Asia: Estimates and Solutions. A Report by Greenpeace'* (2008) 10–11 www.greenpeace.org/archive-india/Global/india/report/2008/3/blue-alert-report.pdf accessed 26 February 2025.

[239] Panda (n 14).

[240] IOM (n 18).

3.3 Legal Frameworks to Protect Climate Migrants

Existing legal frameworks were predominantly framed to address migrations owing to violent conflict or persecution, and not environmental factors. Hence, climate-induced migration does not fall within the purview of these legal protections per se. due to such exclusion millions have been left without support. To resolve these problems in the framework there is an urgent need for reforming current regimes to meet the specific needs of climate migrants globally.

3.3.1 Existing International Legal Framework

The 1951 Refugee Convention and its 1967 Protocol are foundation stone for international protection of refugees. The definition of refugees as per these instruments, is when a person flee his home country to avoid persecution on the basis of race, religion, nationality, membership in a particular social group, or political opinion.[241] Here, environmental degradation or climate change as grounds for the grant of refugee status is not recognized.[242] Despite the principle of non-refoulement, which prohibits returning individuals to territories where their life or freedom would be threatened, the climate migrants are unable to seek this protection.[243] Many scholars argue for a broader interpretation of refugee status to include those

[241] *Convention Relating to the Status of Refugees* (adopted 28 July 1951, entered into force 22 April 1954) 189 UNTS 137; *Protocol Relating to the Status of Refugees* (adopted 31 January 1967, entered into force 4 October 1967) 606 UNTS 267.
[242] Ibid.
[243] UNHCR, 'Guidelines on the Protection of Refugees in the Context of Climate Change' (2018) UN Doc HCR/GUIDELINES/2018/01.

displaced by environmental factors, highlighting a critical gap in protection.[244]

Temporary or provisional protection measures have been adopted in various jurisdictions owing to the absence of a dedicated legal framework for climate migrants. For instance, the United States provides for a Temporary Protected Status (TPS) to its nationals from countries experiencing sudden disasters, including environmental crises.[245] Although TPS provides some temporary relief but it fails to offer long-term security for displaced populations due to its limited scope.[246] Another example is the European Union's Temporary Protection Directive which ensures humanitarian assistance during large-scale displacement events, yet it is primarily formulated to respond to conflict driven migration only.[247] Scandinavian countries like Sweden and Finland, initiated measures to provide asylum-like protections to individuals fleeing environmental disasters.[248] While these developments are encouraging, they are not as yet incorporated into a

[244] McAdam (n 6).
[245] US Citizenship and Immigration Services, 'Temporary Protected Status' (USCIS, 2023) https://www.uscis.gov/humanitarian/temporary-protected-status accessed 26 May 2025.
[246] Intergovernmental Panel on Climate Change, 'Summary for Policymakers' in ML Parry et al (eds), *Climate Change 2007: Impacts, Adaptation and Vulnerability* (Cambridge University Press 2007).

[247] European Parliament and Council Directive 2001/55/EC of 20 July 2001 on minimum standards for giving temporary protection in the event of a mass influx of displaced persons, OJ L 212/12.
[248] Ministry of Justice Sweden, 'Asylum and Climate Change: Emerging Approaches' (Swedish Government, 2020) https://www.government.se/articles/2020/11/asylum-and-climate-change/ accessed 26 May 2025.

comprehensive international legal framework for the protection of climate migrants globally.[249]

3.3.2 *Legal Framework in India*

There is no such mention of the terms like climate migrant, climate induced displacements or migrations in the Constitution of India, but it can be broadly interpreted to fall within the ambit of the Article 21(right to life and personal liberty)[250] which prescribes for the right to live in a clean and healthy environment.[251] The proactive role of Indian judiciary in advancing environmental rights through public interest litigation, indirectly addresses the displacement issues. In the Landmark case of *Municipal Council, Ratlam v Vardhichand* the Indian Supreme Court held that state and local authorities have a duty to ensure basic environmental standards, recognizing their role in safeguarding public health and livelihoods in ecologically sensitive regions.[252] Further, Article 48A imposes a duty on the State to protect and improve the environment.[253] Despite these progressive decisions, there exists no comprehensive legal framework in India specifically addressing the challenges faced by climate-induced migrants.

However, there is a starting of an initiative though. The Climate Migrants (Protection and Rehabilitation) Bill, 2022 is a building block aimed at establishing a comprehensive framework to address climate-induced

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[249] Helene Lambert, 'Climate Displacement and Asylum: Legal Gaps and Emerging Trends in Europe' (2022) 29 IJRL 76.
[250] *Constitution of India* (1950) Art 21.
[251] *Subhash Kumar v State of Bihar* (1991) AIR 420 (SC).
[252] *Municipal Council, Ratlam v Vardhichand (1980) AIR 1622 (SC)*.
[253] Constitution of India 1950, art 48A.

displacement in India.[254] The bill seeks to define the legal status of climate migrants, safeguard their rights, and provide mechanisms for their rehabilitation and resettlement. It further seeks to acknowledge the unique nature of displacement caused by environmental factors such as climate change. Most importantly, it provides for a legal definition of "climate migrant" that encompasses individuals, households, or communities forcibly displaced due to climate-related factors—ranging from sudden-onset disasters such as floods and cyclones to slow-onset processes like sea-level rise, desertification, and glacial melt.[255] This definition covers both involuntary displacements and voluntary relocations owing to unsustainable living conditions, hence climate migrants are seen distinctly from traditional refugees, who are protected in the wake of persecution based on race, religion, nationality, political opinion, or ethnic group.[256] The bill seeks to address the existing protection gap at both international and domestic levels.[257]

In India, a large number of people are at high risk due to the adverse effects of climate change, the bill represents a pioneering effort to provide protection to such vulnerable communities. Judicial interventions have also underscored the right against the adverse effects of climate change.[258] The bill also proposes the establishment of key institutional mechanisms such as a National Climate Migration Authority and a dedicated Climate Migration

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[254] *The Climate Migrants (Protection and Rehabilitation) Bill 2022, Bill No. 160 of 2022 (India), https://www.indialegallive.com/constitutional-law-news/bills/climate-migrants-bill/ accessed 26 May 2025.*
[255] Ibid, s 2.
[256] Convention (n 27), art 1A (2).
[257] Convention (n 27).
[258] *M.K. Ranjitsinh v Union of India* (2022) Writ Petition (Civil) No. 838 of 2019 (SC).

Fund, ensuring coordinate national responses and allocate resources for the rehabilitation of affected populations.[259] Although the bill remains under legislative review, its introduction an incredible step towards recognizing the complex legal and humanitarian challenges posed by climate displacement in India.

3.3.3 *Regional and Bilateral Initiative*

Regional cooperation is very crucial to ensure the effective protection of climate migrants as climate change is transboundary phenomenon. In South Asia, countries share river systems, coastlines and similar climate risks. The South Asian Association for Regional Cooperation (SAARC) offers a platform for dialogue; but owing to persistent geopolitical tensions and a lack of consensus among member states its effectiveness is constrained.[260] For instance, there is hardly any progress seen in matters concerning climate change even after adoption of the SAARC Action Plan on Climate Change in 2008.[261] Similarly, the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), is a promising regional cooperation on disaster resilience and climate adaptation.[262]

Bilateral cooperation is particularly critical between India and Bangladesh, as the two nations share common concerns of environmental vulnerabilities, such as flooding, sea-level rise, and recurrent cyclones in the Bay of

[259] Climate Migrants Bill (n 40).
[260] Adil Najam, Saleemul Huq and Youba Sokona, 'Climate Negotiations beyond Kyoto: Developing Countries Concerns and Interests' (2003) 3(3) CP 221.
[261] SAARC, *SAARC Action Plan on Climate Change* (2008), https://saarc-sec.org/document/saarc-action-plan-on-climate-change/ accessed 26 May 2025.
[262] BIMSTEC, *BIMSTEC Disaster Management Exercise Report 2020*, https://bimstec.org/publications/ accessed 26 May 2025.

Bengal.[263] The "Roadmap to a Framework for the Protection of Climate Migrants" provides for four steps process that is recognition, cooperation, planning, and implementation to ensure legal and institutional protections for climate-displaced persons.[264] These bilateral agreements could serve as models for other regions facing similar challenges.[265]

4. CASE STUDIES

4.1 The Sundarbans: Internal Displacement due to Climate Change

Sundarbans region in India, face increasing climate-induced migration due to sea-level rise, frequent cyclones, and land erosion. Displaced people move to cities like Kolkata, in the search of jobs and safety. However, the lack of adequate legal protection denies them access to essential services.[266] Several small islands, including Lohachara and Suparibhanga, have been submerged due to rising sea levels, displacing entire communities. Cyclones Aila (2009), Amphan (2020), and Yaas (2021) has further exacerbated the crisis, forcing many to migrate to cities like Kolkata, where they now work as daily wage laborers, construction workers, or in informal sectors with no job security.[267] The absence of a national framework for internally displaced

[263] Nazrul Islam and Nicole Stern, 'Bangladesh and Climate Change: A Vulnerable Country's Dilemma' (2011) 4(1) IJCCSM 67.
[264] Ministry of External Affairs (India) and Ministry of Foreign Affairs (Bangladesh), *Roadmap to a Framework for the Protection of Climate Migrants* (2021).
[265] R Zetter, 'The Role of Legal and Normative Frameworks for the Protection of Environmentally Displaced People' in *Migration, Environment and Climate Change: Assessing the Evidence* (International Organization for Migration 2009).
[266] Ashok Swain, *The Environmental Trap: The Ganges River Diversion, Bangladeshi Migration and Conflicts in India* (Uppsala University Press 1996).
[267] Aromar Revi, 'Climate Change Risk: An Adaptation and Mitigation Agenda for Indian States' (2007) *TARU, New Delhi*, background paper, Global Urban Summit, 8–13 July, Bellagio, Italy.

persons (IDPs) due to environmental hazards means that displaced populations often lack access to government rehabilitation programs, social security, and housing assistance.[268] Migrants moving to cities strains urban infrastructure, increasing competition for jobs and resources.[269]

Despite the large-scale displacement India does not have a national policy addressing climate-induced migration. Existing disaster management rules focus on short-term relief, and not on long-term rehabilitation. A structured approach that includes legal recognition, livelihood support, and sustainable urban planning is urgently required to address the challenges faced by climate migrants in India's coastal regions.

4.2 The Pacific Islands: Rising Sea Levels and Displacement

Small island nations in the Pacific—such as Kiribati, Tuvalu, and the Maldives— are among the most critically endangered regions due to rising sea levels caused by climate change. These islands are under an extreme threat due to their low-lying elevation and limited landmass.[270] The communities have already experienced critical loss in these regions including contaminated freshwater resources and disruption in traditional agriculture and fisheries.[271] Scholars have argued for the recognition of climate migrants from these regions within international law—either by

[268] Ranabir Samaddar, *The Marginal Nation: Transborder Migration from Bangladesh to West Bengal* (Sage 1999).
[269] 'Vanishing Islands Displaced Climate Casualties Underlying Truth' *The Telegraph* (Calcutta, 30 October 2006).
[270] John Campbell and Jon Barnett, *Climate Change and Small Island States: Power, Knowledge and the South Pacific* (Earthscan 2010).
[271] United Nations Office for the Coordination of Humanitarian Affairs (OCHA), *Climate Change in the Pacific: Human Security and Development Needs* (OCHA 2009) https://www.unocha.org accessed 26 May 2025.

expanding the definition of "refugee" under the 1951 Refugee Convention or by adopting a new legal instrument specifically for climate-induced displacement.[272] Further, regional cooperations such as bilateral and multilateral resettlement agreements may provide for temporary solutions. For instance, New Zealand and Australia have been encouraged to build for structured pathways for Pacific Islanders at risk of displacement.[273] Such regional agreements, could facilitate in managing retreat and preserving cultural identity in the face of forced migration.[274]

4.3 Bangladesh: River Erosion, Cyclones, and Urban Displacement

Bangladesh is among the most climate-vulnerable regions globally, facing frequent cyclones, flooding, and riverbank erosion.[275] This environmental degradation is the prime reason for large scale internal displacements, forcing communities in rural areas to migrate to urban centers in search of safer living conditions. The submergence of cultivable land and depletion of freshwater resources not only exacerbate poverty but also undermine long-term socio-economic resilience.[276] Even in the face of such crisis, Bangladesh lacks a comprehensive national legal framework to safeguard the rights and welfare of internally displaced persons (IDPs) affected by

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[272] Walter Kälin and Nina Schrepfer, *Protecting People Crossing Borders in the Context of Climate Change: Normative Gaps and Possible Approaches* (UNHCR Legal and Protection Policy Research Series 2012) https://www.unhcr.org accessed 26 May 2025.
[273] John Podesta and Peter Ogden, 'The Security Implications of Climate Change' (2007) 31(1) WQ 115.
[274] C Montreux and J Barnett, 'Climate Change, Migration and Adaptation in Funafuti, Tuvalu' (2009) 19 GEC 105.
[275] Intergovernmental Panel on Climate Change, *Climate Change 2022: Impacts, Adaptation and Vulnerability* (IPCC 2022).
[276] United Nations Development Programme, *Climate Change and Bangladesh: Policy, Planning and Institutions* (UNDP 2021).

climate hazards.[277] The displaced communities often lack access to essential facilities, housing, and legal recourse.[278] Urgent legislative reforms are necessary to mitigate both the causes and consequences of climate-induced displacement.[279]

4.4 The Horn of Africa: Drought, Conflict, and Forced Migration

The Horn of Africa, includes countries such as Somalia, Ethiopia, and Kenya. These countries are experiencing acute and recurrent droughts, increasingly intensified by climate change.[280] These climate shocks are furthered by political instability and violent conflicts, leading to food insecurity and significant displacement across the region.[281] The displacement in this region is complex in nature, involving both internal movements and cross-border movements.[282] In regions where drought and conflict co-exist, it is often challenging to clearly attribute displacement to environmental factors, further complicating legal and humanitarian responses.[283] Many displaced individuals in the Horn of Africa are denied humanitarian assistance and formal recognition in neighboring countries

[277] Refugees International, *A Framework for Action: Addressing Climate Displacement in Bangladesh* (Refugees International 2022).
[278] Human Rights Watch, *"Are We Not Human?" Denial of Rights to Climate Displaced in Bangladesh* (HRW 2023).
[279] United Nations High Commissioner for Refugees, *Legal and Normative Frameworks for the Protection of Climate Displaced Persons* (UNHCR 2022); Global Centre for Climate Mobility, *Pathways to Protection: Legal Responses to Climate Mobility* (GCCM 2023).
[280] IPCC (n 64).
[281] Food and Agriculture Organization, *Drought in the Horn of Africa: Rapid Response and Mitigation Plan* (FAO 2022).
[282] International Organization for Migration, *Horn of Africa Regional Migration Overview* (IOM 2021).
[283] Alex de Sherbinin and others, 'Climate Change and Migration in Africa: Challenges and Policy Responses' (2022) 7 MD 1.

owing to the lack of their recognition in legal frameworks.[284] Integrating climate change induced displacement considerations into regional frameworks, such as the Kampala Convention, could enhance protection for those affected.[285]

4.5 The Mekong Delta, Vietnam: Salinization and Agricultural Displacement

The Mekong Delta in Vietnam is a crucial agricultural region for rice cultivation and aquaculture. This region is severely threatened by saltwater intrusion owing to rise in sea levels and upstream dam construction along Mekong River.[286] Due to the progressive salinization soil the agricultural yields have been significantly reduced, resulting in food insecurity and ultimately forcing many farming households to abandon their land and migrate.[287] Since the existing displacement frameworks are largely formulated for sudden disasters or conflict situations, the slow-onset nature of such environmental degradation poses significant legal and policy challenges in the region.[288] Legal framework must evolve to incorporate protections for those displaced by slow-onset of climate impacts—such as

[284] Human Rights Watch, *"No One Asked Us": Climate-Induced Displacement in the Horn of Africa* (HRW 2023).
[285] African Union, *African Union Convention for the Protection and Assistance of Internally Displaced Persons in Africa (Kampala Convention)* (adopted 23 October 2009, entered into force 6 December 2012).
[286] IPCC (n 64).
[287] United Nations University Institute for Environment and Human Security, *Loss and Damage in the Mekong Delta: Slow-Onset Disasters and Climate Mobility* (UNU-EHS 2021).
[288] McAdam (n 6).

resettlement planning, livelihood rehabilitation, and localized, community-led adaptation measures.[289]

5. CONCLUSION AND RECOMMENDATIONS

Climate-induced displacement is an emerging humanitarian and legal issue, particularly for climate-vulnerable regions like India and its South Asian neighbours. It is no longer a distant problem and is faced by millions on regular basis owing to erratic climate conditions. Existing legal and policy frameworks, at both domestic and international level, were never designed to address the complex nature of climate migration. To address the significant gaps in existing legal frameworks, a comprehensive legal protection measures are urgently required for climate migrants that operate at the international, regional, and domestic levels. Here are some proposed recommendations:

Internationally, climate migrants can be protected by expanding the ambit of the definition of "refugee" under the 1951 Refugee Convention to include environmental factors including climate change. Additionally, drafting a new international protocol dedicated to the rights and protection of climate-displaced persons could also be a great solution. Any such new definition should include both sudden disasters and slow-onset environmental changes that force communities to migrate.

Regionally, cooperation among countries in the same region is very important since they share common environmental challenges and historical migration patterns. In South Asian region, India must initiate toward binding

[289] United Nations Framework Convention on Climate Change, *Technical Paper on Slow Onset Events* (UNFCCC 2012) FCCC/TP/2012/7.

regional or bilateral agreements—particularly with Bangladesh and Nepal. Such agreements should include mechanisms for temporary protection, cross-border aid, and long-term resettlement options. The “Roadmap to a Framework for the Protection of Climate Migrants” (2021) offers a strong model that can be adapted to the regional context, with its focus on four pillars that is, recognition, cooperation, planning, and implementation.

Nationally, there is an urgent need for a dedicated legal framework to address climate-induced migration within India. While there are environmental and disaster laws but none of them explicitly recognize the category of "climate migrant." The proposed *Climate Migrants (Protection and Rehabilitation) Bill, 2022* is a promising step. It offers a structured approach by defining climate migrants, establishing a National Climate Migration Authority, creating a Climate Migration Fund, and guaranteeing rights-based resettlement and rehabilitation. However, for its effective implementation it is pertinent that the proposed legislation must prioritise both internal displacements and cross border migrations specifically. This would require India to actively invest in climate-resilient infrastructure, adoption sustainable agricultural practices, and building of robust disaster risk reduction strategies that allow communities to adapt in place rather than migrate out of necessity. Climate-induced migrations in India are undocumented and unregulated due to the lack of a reliable and centralized system to track the scale, patterns, and drivers of such migrations. Building of an infrastructure that can target interventions, allocate resources effectively, and monitor the long-term trends is very crucial. Taking all such measures can give India a stronghold in the region and it can ensure due legal protections to climate migrants in the region.

In conclusion, the increasing climate-induced displacement can only be addressed through a collective global response and an urgent action-based mechanism at regional and domestic level. Through innovative legal frameworks, collective action, and proactive adaptation strategies, it is possible to ensure the dignity, rights and security of people displaced due to climate change.

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