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Climate Change Policies of Bangladesh: A Review

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Abstract

This comprehensive review delves into Bangladesh's evolving response to escalating climate change impacts from the Initial National Communication (INC) report in 2002 to the National Adaptation Plan (NAP) in 2023. Leveraging a Policy Cycle Analysis framework, the study examines key national initiatives, highlighting the nation's profound vulnerability and the policies driven by a complex interplay of international commitments, scientific research, and pressing sustainable development goals. While acknowledging proactive measures, the review critically identifies and substantiates significant policy gaps, particularly concerning data accuracy in emission inventories, the inclusivity and equitable distribution of adaptation strategies, and the imperative for targeted technological advancements. The analysis is bolstered by empirical evidence detailing, for example, misallocation of funds, data shortfalls in agricultural adaptation, limited reach of climate finance to vulnerable groups, and systemic weaknesses in monitoring and coordination across various policies. This paper underscores the multifaceted nature of climate change challenges, emphasizing the ongoing need for dynamic adaptation, enhanced collaboration, and continuous innovation. The conclusion stresses the urgency for impactful, evidence-based policies in the face of rising sea levels and extreme weather events, commending Bangladesh's commitment to a safe, climate-resilient future. Advocating for continuous policy evolution guided by lessons learned and informed by robust data, this review serves as a succinct overview, acknowledging achievements and underscoring the imperative of ongoing, nuanced efforts

in the rapidly changing climate landscape.

Subject Areas

Atmospheric Sciences

Keywords

Climate Change, Policy Review, Bangladesh, Adaptation, Mitigation, Policy Gaps, Policy Cycle Analysis, Climate Resilience

1. Introduction

Climate change refers to long-term alterations in temperature, precipitation, wind patterns, and other components of the Earth's climate system. It arises from both natural variability and anthropogenic (human-induced) drivers, particularly the increase in greenhouse gas emissions that trap heat in the atmosphere [1] [2]. Temperature and humidity levels can fluctuate due to the influence of both natural and man-made structures. In natural environments, particularly during the warmer months, these two variables often exhibit an inverse relationship [3]. Globally, climate change has intensified extreme weather events, accelerated sea-level rise, threatened food and water security, and caused widespread ecological and socioeconomic disruptions [4] [5]. Climate change poses multifaceted challenges to the world, impacting ecosystems, economies, and societies across all regions. One of the most immediate threats is the increased frequency and intensity of extreme weather events such as heatwaves, floods, droughts, and cyclones, which result in loss of lives, property damage, and disruption of livelihoods [4]. Rising global temperatures contribute to accelerated glacial melt and sea-level rise, threatening the existence of low-lying coastal areas and small island nations [6]. Climate change also affects food production by altering rainfall patterns and increasing the incidence of pests and crop failures, thereby endangering food security, especially in developing countries [7]. In addition, the changing climate exacerbates water scarcity in arid and semi-arid regions and intensifies health risks through the spread of climate-sensitive diseases such as malaria, dengue, and heat stress-related illnesses [8]. Furthermore, the economic burden of climate-induced disasters and adaptation costs strains national budgets, particularly in vulnerable nations with limited financial and technological resources [9]. Collectively, these challenges underscore the urgent need for global cooperation in climate mitigation and adaptation efforts. To mitigate the diverse and escalating challenges posed by climate change, the global community has implemented a range of international policies and established key organizations aimed at reducing greenhouse gas emissions, enhancing resilience, and promoting sustainable development. A landmark initiative is the Paris Agreement, adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), which commits na-

tions to limit global warming to well below 2˚C above pre-industrial levels, with efforts to keep it below 1.5˚C [10]. Countries are required to submit Nationally Determined Contributions (NDCs) outlining their emission reduction targets and adaptation strategies. In addition, the Kyoto Protocol (1997) was an earlier treaty that established legally binding obligations for developed countries to reduce emissions. Organizations such as the Intergovernmental Panel on Climate Change (IPCC) play a crucial role in supporting these goals by providing scientific assessments that inform policy decisions [2]. Financial mechanisms like the Green Climate Fund (GCF) were created to assist developing countries in funding mitigation and adaptation projects. Other influential bodies include the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), which coordinate climate research, policy guidance, and early warning systems globally. Collectively, these policies and institutions form a robust framework for addressing climate change, though their success depends on sustained international cooperation and implementation.

Bangladesh, as one of the most climate-vulnerable countries in the world, has experienced severe and escalating impacts from climate change between 2002 and 2025. These include intensified cyclones such as Sidr (2007), Aila (2009), and Amphan (2020), frequent and prolonged flooding, rising sea levels, and increasing salinity in coastal regions. Additionally, riverbank erosion and drought have disrupted livelihoods and displaced millions, severely affecting agricultural productivity and water security [4] [11]-[14]. In response, Bangladesh has implemented several proactive adaptation policies and strategies to mitigate these risks and enhance national resilience. Key among these is the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) introduced in 2009, which identifies six priority areas including food security, disaster management, and climate-resilient infrastructure. Furthermore, the Bangladesh Climate Change Trust Fund (BCCTF), established in 2010, has financed more than 700 adaptation and mitigation projects. The National Adaptation Programme of Action (NAPA) and the National Adaptation Plan (NAP), submitted in 2023 to the UNFCCC, further provide policy frameworks promoting locally-led adaptation, climate-smart agriculture, and nature-based solutions. Other sectoral plans, such as the Delta Plan 2100 and the Mujib Climate Prosperity Plan (MCPP), highlight long-term climate resilience through integrated water management and green economic transitions [12] [15] [16]. Despite these efforts, the complexity of climate-induced challenges demands ongoing scrutiny of the existing policy frameworks. Bangladesh's adaptation approach has evolved in a broader global context, where climatic patterns—such as shifting rainfall regimes, changes in ocean salinity, and rising sea levels—have intensified [17]. Particularly noteworthy is the emerging discourse on migration as an adaptive strategy, which challenges traditional perspectives that frame migration solely as a climate-induced crisis. Contemporary research presents migration as a viable, proactive response to environmental stressors [18]-[20].

Bangladesh, identified as one of the most vulnerable countries to climate change

[21] [22], has responded with commendable efforts from governments, civil society organizations, and development partners to address the impacts of frequent and extreme climatic events [23]. The discourse surrounding migration as an adaptive strategy in the face of climate change introduces a novel perspective. Traditionally viewed as a challenge [24]-[26] recent theoretical and empirical studies [18]-[20] present migration as a potential solution. This paradigm shift raises questions about the efficacy of existing policies in embracing and facilitating migration as a proactive adaptation measure. This critical review seeks to unravel the nuances of such policies, delving into their alignment with the evolving climate landscape and the potential impediments or facilitators they present to effective adaptation. In navigating this exploration, it is essential to acknowledge the broader context of global climate change, as evidenced by widespread shifts in rainfall, ocean salinity, wind patterns, and an increase in extreme weather events [17]. The observed rise in sea levels over the past century serves as a tangible indicator of the evolving climate [17].

This review aims to assess the responsiveness of Bangladesh's policies to these global climate trends and their effectiveness in fostering adaptation at the local level. This review employs Kingdon's Multiple Streams Framework [27] to dissect how problem recognition (e.g., sea-level rise), policy solutions (e.g., BCCSAP), and political will (e.g., CVF leadership) converged to shape Bangladesh's climate agenda. Policy effectiveness is further evaluated using Dunn's Criteria [28], assessing efficiency (resource allocation), equity (gender/inclusion), and adaptability (NAP revisions). This dual-lens approach moves beyond description to reveal systemic drivers and constraints. Ultimately, the review seeks to pave the way for informed recommendations and potential refinements in climate change policies for the resilience and sustainable development of Bangladesh in a changing climate scenario.

2. Methodological Approach

The review moves beyond a purely descriptive analysis by adopting a Policy Cycle Analysis framework to systematically examine Bangladesh's climate change policies from 2002 to 2023. This framework provides a structured lens through which to assess policy formulation, implementation, and evaluation, enabling a deeper understanding of the processes and challenges involved.

Policy Cycle Analysis

The Policy Cycle Analysis typically comprises several stages: agenda setting, policy formulation, decision-making, policy implementation, and policy evaluation. While this review primarily focuses on the enacted policies and their observed impacts and gaps, the framework helps to contextualize policy developments and identify areas of strength and weakness across different stages. For instance, understanding the drivers (agenda setting) helps explain the nature of policies formulated, and analyzing gaps often points to deficiencies in implementation or

evaluation. This approach allows for a more critical assessment of policy effectiveness rather than a mere chronological recounting.

3. Drivers of Climate Policy: A Political Economy Lens

Bangladesh's climate policy evolution demonstrably reflects a dynamic interplay between global pressures and intricate domestic realities. Political drivers have consistently influenced policy acceleration, particularly as electoral cycles often prompt rapid post-disaster policy formulation, such as the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) following Cyclone Aila. However, the efficacy of such policies has frequently been hindered by fragmented governance structures, exemplified by the eleven agencies tasked with overseeing the National Adaptation Plan (NAP), leading to coordination challenges. Concurrently, economic drivers have played a dual role; while the Climate Trust Act (2010) represented a significant domestic commitment, allocating 0.8% of GDP to climate initiatives, its implementation has been marred by issues of rent-seeking, resulting in only 24% of funds reportedly reaching target communities [29]. Furthermore, social drivers, notably robust NGO advocacy, have been instrumental in securing progressive provisions, such as gender considerations within the Mujib Climate Prosperity Plan (2021). Yet, the benefits of these advancements have been constrained by elite capture, significantly limiting their reach and impact on rural women [30]. Ultimately, while international commitments, such as those under the UNFCCC, have provided essential scaffolding for policy development, local power dynamics often emerge as the decisive factor dictating actual policy outcomes.

The genesis of Bangladesh's climate change policies is a confluence of diverse factors, each contributing to the formulation of strategic initiatives aimed at addressing the challenges posed by climate change. The creation of the Initial National Communication (INC) report in 2002 was propelled by a compelling need to adopt sustainable measures, align with international commitments, and respond to the outcomes of scientific research [31]. This report emerged as a comprehensive response to the urgent demand for holistic plans to combat the multifaceted issues arising from climate change. In 2010, the Bangladesh Climate Change Trust Act came into existence with a clear priority on industries crucial for sustainable development, particularly agriculture and water resources. The primary driver behind this legislative move was the imperative need for climate resilience, even though technical intricacies were not frequently reported [32]. Collaboration between international organizations, governmental bodies, and environmental agencies culminated in the development of the Second National Communication to UNFCCC in 2012. The driving force behind this collaborative effort was to promote comprehensive and successful climate action by aligning national strategies with international climate objectives [33]. The inception of the Climate Change Gender Action Plan in 2013 was steered by the ambition to foster the adoption of gender-responsive climate policies. It aimed to enhance women's

participation in decision-making and incorporate financial mechanisms tailored to the unique difficulties faced by women in the context of climate change [34]. The Climate Public Expenditure and Institutional Review, spanning multiple years, strategically targeted the energy, agriculture, and infrastructure sectors. Creative problem-solving, even in the face of technical challenges such as missing data and monitoring issues, was a testament to a collaborative approach involving international organizations, government agencies, and stakeholders. This approach maximized financial resources and improved institutional efficiency for spending on effective and efficient climate change measures [35]. The NAPA initiative in 2005 was unequivocally driven by the overarching goals of sustainable development in Bangladesh. Emphasizing stakeholder engagement and proposing adaptation plans for vulnerable coastal areas, NAPA sought to reduce the impacts of climate change while promoting sustainable development through community zone initiatives [36]. The Mujib Climate Prosperity Plan 2030, introduced in 2021, set ambitious milestones such as the development of the Mujib Bongoposagor Independence Giga Array and stability in least-cost modeling studies. The strategy aimed to maximize solar power usage in public areas, convert existing fossil facilities through recapitalization, and set the stage for the use of 40% renewable energy by 2041 and 100% by 2050 [37]. The Bangladesh Delta Plan 2100, established in 2020, aimed to ensure resilient and inclusive water governance strategies. This was driven by the need to safeguard water and long-term food security, promote economic growth, ensure environmental sustainability, and effectively manage natural disasters and climate change challenges [38]. The Nationally Determined Contribution (NDC) in 2021 emerged as a policy influenced by climate change impact and positive economic and environmental effects. It reflected the impact of developments in clean technology, international assistance, and public pressure on bold climate measures [39]. In 2023, the National Adaptation Plan (NAP) hinges its success on funding, tech innovation, climate knowledge dissemination, research, and a host of strategic elements. These collectively drive effective and tailored climate adaptation efforts, emphasizing the multifaceted nature of the approach [40].

The drivers behind Bangladesh's climate change policies are a complex interplay of environmental imperatives, international commitments, technological advancements, socio-political dynamics, and a commitment to sustainable development. While these policies showcase the nation's dedication to climate resilience, they also highlight the ongoing challenges that require continuous adaptation and innovation in policy formulation and implementation.

4. Policy Landscape of Bangladesh

The saga of Bangladesh's response to the challenges posed by climate change begins in 2002 with the submission of the Initial National Communication (INC) report to the UNFCCC. This foundational document outlines a comprehensive strategy encompassing greenhouse gas (GHG) inventory, vulnerability assess-

ments, and adaptation and mitigation measures, providing a strategic foundation for future engagements [31]. In 2005, responding to the scientific community's grave concerns, the Ministry of Environment and Forests established the National Adaptation Programme of Action (NAPA). This marked a proactive step, engaging stakeholders and proposing adaptive solutions, particularly for vulnerable coastal regions, aligning with sustainable development goals and showcasing Bangladesh's commitment to climate resilience [36]. The climate narrative of Bangladesh further unfolds in 2009 with the Bangladesh Climate Change Strategy and Action Plan (BCCSAP). This plan identifies climate change impacts, integrates adaptation and mitigation techniques, and aligns with the Bali Roadmap. It addresses resilience, poverty eradication, community well-being, disaster risk reduction, and the promotion of green technology [41]. The legislative landscape evolves in 2010 with the enactment of the Bangladesh Climate Change Trust Act. This pivotal law outlines strategies for climate resilience, emphasizing funding for capacity-building, research, and adaptation projects, demonstrating Bangladesh's commitment to sustainable practices and a business-centric approach to climate challenges [32]. The narrative progresses to 2012 with the submission of the Second National Communication to UNFCCC. This communication provides an in-depth overview of Bangladesh's climate actions, emphasizing effective mitigation strategies while maintaining a delicate balance with adaptive measures, showcasing a commitment to global climate goals and economic growth [33]. Recognizing the intersectionality of climate change and gender, 2013 witnesses the introduction of the Climate Change Gender Action Plan. This initiative highlights women's leadership in decision-making and introduces gender-aware climate finance mechanisms, promoting an inclusive and sustainable strategy for strengthening community resilience [34]. In 2014, the Climate Public Expenditure and Institutional Review takes center stage. This review aims to enhance transparency in climate-related expenditures, increase institutional efficiency, and optimize financial resources. Prioritizing cost-effective interventions, it fortifies governance frameworks for sustainability and resilience [35]. The narrative unfolds in 2021 with the Mujib Climate Prosperity Plan (MCPP). Launched during Bangladesh's second term as president of the Climate Vulnerable Forum, this plan focuses on leveraging advanced technology, optimizing growth, and boosting employment in the green economy in response to the escalating vulnerability to climate change [37]. The Bangladesh Delta Plan 2100, unveiled by the General Economics Division in collaboration with the government of the Netherlands, becomes a pivotal chapter in the climate story. This long-term vision for the development of the Bangladesh Delta outlines a holistic approach with 19 themes, aiming for a safe, climate-resilient, and affluent delta by the end of the twenty-first century [38]. The year 2014 introduced the Description of Climate Fiscal Framework, offering a financial blueprint to manage climate finances, reduce vulnerability, manage disasters, and enhance adaptation policy, increasing overall capacity [42]. In 2015, the Intended Nationally Determined Contribution (INDC) becomes a cornerstone, proposing

a two-pronged strategy focusing on reducing GHG emissions by 5% by 2030 while ensuring food security and disaster management. Priorities include infrastructure development, rural electrification, urban resilience, ecosystem-based adaptation, community conservation, and capacity building [43]. The narrative extends to 2017 with the unveiling of the Country Investment Plan, emphasizing the interconnectedness of environmental issues affecting human health, livelihoods, and ecosystems. Issues addressed encompass pollution, climate change, natural resource management, and governance [44]. In 2018, the Third National Communication to UNFCCC presents a budget for comprehensive efforts to combat climate change. This report prioritizes the transition to a low-carbon, climate-resilient economy, addressing barriers and promoting sustainable climate initiatives while exploring gender issues associated with climate change [12]. The journey continues to 2021 with the Nationally Determined Contribution (NDC) update, underscoring Bangladesh's commitment to additional mitigation measures. This commitment aims to reduce emissions and ensure a transition to a low-carbon, climate-resilient economy, while avoiding surpassing the average per capita emissions of developing nations [39]. The most recent chapter unfolds in 2023 with the publication of the National Adaptation Plan (NAP). This strategic framework, released by the Ministry of Environment, Forests, and Climate Change, outlines measures to increase resilience to the effects of climate change. Covering topics such as water management, agriculture, climate financing, and stakeholder engagement, NAP 2023 reflects Bangladesh's ongoing commitment to adapting and mitigating the impacts of climate change [40]. The narrative stands as a testament to Bangladesh's tireless efforts to navigate the complex challenges of climate change, showcasing a continuous evolution towards a more resilient and sustainable future.

Policies in Actions: Actors and Interventions

The story of Bangladesh's resilience in the face of climate change unfolds as a narrative of strategic evolution, policy formulation, and the tireless efforts of various factors. This journey began in 2002 with the submission of the Initial National Communication (INC) report to the UNFCCC. Orchestrated by the Ministry of Environment and Forest (MoEF), this document laid the groundwork for addressing greenhouse gas (GHG) emissions, vulnerabilities, and the imperative need for adaptation and mitigation tailored to Bangladesh's unique context. A pivotal moment in this narrative arrives in 2005 with the establishment of the National Adaptation Programme of Action (NAPA). In the capable hands of MoEF, this initiative demonstrated Bangladesh's proactive response to the escalating risks associated with climate change. The program meticulously planned and designed water management strategies, improved urban infrastructure resilience, adapted agricultural systems, and ensured a supply of drinking water to vulnerable coastal areas. As the challenges intensified, Bangladesh fortified its stance with the Bangladesh Climate Change Strategy and Action Plan in 2009. Spearheaded by the Min-

istry of Environment and Forests, this comprehensive plan not only aimed to reduce climate change impacts but also integrated adaptation and mitigation strategies. Following the Bali Roadmap, it delineated a roadmap for resilience, poverty eradication, community well-being, disaster risk reduction, and the incorporation of green technology. The legislative landscape witnessed a transformative moment in 2010 with the enactment of the Bangladesh Climate Change Trust Act. Under the stewardship of MoEF, this act outlined essential steps for enhancing climate resilience, fostering a business-centric approach, and aligning with sustainability goals, thereby ensuring a holistic response to climate challenges. In 2012, Bangladesh articulated its commitment to global climate goals through the Second National Communication to UNFCCC. The Ministry of Environment and Forest (MoEF) took the lead in this endeavor, emphasizing improved climate action, addressing emerging issues, and prioritizing sustainable solutions for significant global contributions. Recognizing the gender dimensions of climate change, 2013 witnessed the introduction of the Climate Change Gender Action Plan. MoEF, in collaboration with stakeholders, incorporated gender-responsive strategies to address the unique vulnerabilities faced by women. This plan ensured a sustainable and inclusive approach for building resilient communities. The year 2014 marked a significant stride in transparency and efficiency with the Climate Public Expenditure and Institutional Review. Under the jurisdiction of the Planning Commission, this review aimed to ensure transparency in climate-related expenditures, enhance institutional efficiency, and optimize financial resources for sustainable climate initiatives. Simultaneously, the Climate Fiscal Framework, proposed in 2014 by the Ministry of Finance, provided a financial blueprint to manage climate finances, thereby reducing vulnerabilities and bolstering the nation's capacity to navigate the challenges posed by climate change. In 2015, Bangladesh unveiled its Intended Nationally Determined Contribution (INDC), reinforcing its commitment to combat climate change. Orchestrated by the Ministry of Environment and Forests (MOEF), this two-fold strategy aimed to reduce GHG emissions by 5% by 2030 while ensuring food security and effective disaster management. The priorities included infrastructure development, rural electrification, urban resilience, ecosystem-based adaptation, community conservation, and capacity building. The Country Investment Plan of 2017, led by the Ministry of Environment and Forests (MOEF), highlighted the interconnectedness of environmental issues affecting human health, livelihoods, and ecosystems. This plan addressed climate change, pollution, natural resource management, and environmental governance. In 2018, the Third National Communication to UNFCCC provided a comprehensive overview of Bangladesh's climate budget. Led by the Ministry of Environment, Forest and Climate Change, this report emphasized the transition to a low-carbon, climate-resilient economy. It also delved into gender issues associated with climate change and showcased existing policies while suggesting sustainable climate initiatives. The Bangladesh Delta Plan 2100, unveiled in 2020 under the guidance of the General Economics

Division, Bangladesh Planning Commission, outlined a visionary approach. Aimed at minimizing poverty, maximizing income, ensuring safety from climatic disasters, and sustainably managing river systems and estuaries, this plan charted a course for a safe, climate-resilient, and affluent delta. In 2021, under the presidency of the Climate Vulnerable Forum (CVF), Bangladesh introduced the Mujib Climate Prosperity Plan 2030. This plan, focused on strengthening financial security, developing green economic relationships, extending the digital economy, and improving gender responsiveness, sought to promote employment in the green economy and ensure adaptability, energy security, and independence. The same year witnessed an update to the Nationally Determined Contribution (NDC), highlighting Bangladesh's commitment to additional mitigation measures. The plan aimed to reduce greenhouse gas emissions, increase solar energy usage in agriculture, utilize energy-saving appliances, strengthen waste management systems, and enhance energy efficiency in the industrial subsector. The most recent chapter, in 2023, unfolds with the publication of the National Adaptation Plan (NAP). Orchestrated by the Ministry of Environment, Forest and Climate Change, this plan addresses a myriad of challenges. From protecting cropland from storm surges to engaging the private sector in financing adaptation, the plan covers climate financing, transformative capacity, technology transfer, and inclusivity regarding gender, disability, youth, and social inclusion.

This narrative underscores Bangladesh's unwavering commitment to navigating the complex terrain of climate change. It reflects a nation that has evolved its strategies, engaged multiple stakeholders, and forged a path towards resilience, sustainability, and prosperity in the face of an ever-changing climate landscape. In Table 1, the policies and implementation has been illustrated.

Table 1. Policy ımplementation in bangladesh.

Year	Policy/Initiative	Lead Agency	Key Interventions
2002	INC Report to UNFCCC	MoEF, GoB	GHG emissions, vulnerabilities, adaptation, mitigation
2005	NAPA	MoEF, GoB	Risks reduction, water management, urban infrastructure resilience, agricultural adaptation
2009	Climate Change Strategy and Action Plan	MoEF	Impact reduction, adaptation, integration, mitigation, Bali Roadmap alignment
2010	Climate Change Trust Act	MoEF, GoB	Climate resilience, business-centric approach, sustainability goals
2012	Second National Communication to UNFCCC	MoEF	Improved climate action, sustainable solutions, global contributions
2013	Climate Change Gender Action Plan	MoEF	Gender-responsive strategies, resilient communities
2014	Climate Public Expenditure and Institutional Review	Planning Commission, GoB	Transparency, institutional efficiency, financial optimization
2014	Climate Fiscal Framework	Ministry of Finance	Financial blueprint, reducing vulnerability

Continued

2015	Intended Nationally Determined Contribution	MOEF	GHG reduction, food security, disaster management, infrastructure, resilience
2017	Country Investment Plan	MOEF	Environmental issues, pollution, natural resource management, governance
2018	Third National Communication to UNFCCC	MoEF	Climate budget, low-carbon economy, gender issues, sustainable initiatives
2020	Bangladesh Delta Plan 2100	General Economics Division, Planning Commission	Poverty reduction, income maximization, safety from climatic disasters
2021	Mujib Climate Prosperity Plan 2030	Climate Vulnerable Forum	Financial security, green economy, digital economy, gender responsiveness
2021	Nationally Determined Contribution Update	-	GHG reduction, solar energy, energy efficiency, waste management
2023	National Adaptation Plan	MoEF	Cropland protection, private sector engagement, climate financing, inclusivity

5. Comparative Contexts and Implications

The insights derived from Bangladesh's climate policy landscape offer valuable lessons that can be generalized to, and further enriched by, comparative analysis with other climate-vulnerable nations. While a detailed comparative study is beyond the scope of this review without specific data from other countries, considering Bangladesh's experiences alongside those of similar nations (e.g., Vietnam, the Philippines, or small island developing states) can illuminate shared challenges and diverse approaches to climate resilience.

Comparative Lessons from Climate-Vulnerable Nations

Bangladesh's experience in developing and implementing climate change policies reflects common challenges encountered by other highly climate-vulnerable nations, providing valuable comparative lessons for scientific discourse. For instance, similar to Bangladesh's National Adaptation Programme of Action (NAPA) in 2005, the Maldives' National Adaptation Program (2012) also strategically prioritized coastal resilience as a cornerstone of its climate response. However, both nations subsequently grappled with significant decentralization failures, primarily attributable to persistent fiscal gaps that hindered effective local-level implementation and resource mobilization [45]. Likewise, Vietnam's Climate Change Strategy (2011) mirrored the ambitions of Bangladesh's Climate Change Strategy and Action Plan (BCCSAP) 2009 by attempting to integrate comprehensive cross-sectoral targets to foster a more holistic approach to climate adaptation and mitigation. Nevertheless, Vietnam's efforts were significantly hampered by pervasive data fragmentation, which severely weakened the efficacy of its monitoring and evaluation frameworks [46]. These parallel experiences underscore a critical insight: while policy frameworks may articulate ambitious goals and integrate best practices, their practical implementation in climate-vulnerable developing nations is frequently constrained by systemic issues such as financial shortfalls, inadequate decentralized governance, and fragmented data infrastruc-

ture, necessitating a more integrated and resource-supported approach to policy design and execution. These cases highlight that institutional coordination and domestic financing remain significant barriers to effective climate policy implementation in Global South nations, as illustrated in Table 2.

Table 2. Policy implementation gaps, Bangladesh vs. Peers.

Gap Area	Bangladesh	Maldives	Vietnam
Data Accuracy	NAPA's outdated agricultural data (62% pre-2000; WB 2019)	No national GHG inventory until 2020	Inconsistent flood modeling datasets
Gender Inclusion	Gender Action Plan (2013) lacked grassroots consultation	Female exclusion from island relocation decisions	Women underrepresented in REDD+ projects
Financing	37% of Climate Trust Fund misallocated (TI, 2017)	Heavy reliance on international aid	Limited private-sector climate investment

This comparative perspective would transform the findings from country-specific observations into broader lessons for global climate action in highly vulnerable regions.

6. Analyzing Gaps in Bangladesh's Climate Change Policies: A Comprehensive Perspective

Bangladesh, grappling with the impacts of climate change, has demonstrated a steadfast commitment to formulating policies aimed at sustainable development and climate resilience. However, a nuanced examination, supported by available data and reviews, reveals critical gaps that warrant in-depth consideration for effective implementation and adaptation.

6.1. Gaps in INC Report to UNFCCC 2002

The Initial National Communication (INC) Report to the UNFCCC in 2002, as Bangladesh's first formal submission, served as a foundational document outlining its greenhouse gas emissions, vulnerabilities, adaptation needs, and mitigation efforts. However, being an initial report, it inherently had limitations. Key gaps likely included a reliance on older or less comprehensive data for GHG inventories, leading to potential inaccuracies in emission estimations across various sectors. The understanding of climate change impacts, vulnerabilities, and the development of specific adaptation and mitigation strategies was still nascent, often lacking detailed actionable plans, robust monitoring and evaluation frameworks, and clear pathways for technology transfer or private sector engagement. Furthermore, while identifying broad areas of concern, it may not have sufficiently delved into cross-sectoral coordination challenges or specific regional/local vulnerabilities, which became more apparent in subsequent national communications and action plans.

6.2. Gaps in National Adaptation Programme of Action (NAPA) 2005

The National Adaptation Programme of Action (NAPA) 2005, while founda-

tional, exhibited several critical gaps in its approach to climate change adaptation. In water resources management, there was inadequate integration of climate change considerations, a lack of actionable strategies for water resource planning, and no clear mechanisms to address sedimentation and riverbed rise. For coastal zone management, planning for salinity intrusion remained limited, lacking specific strategies for freshwater conservation or desalination, and existing coastal embankments did not sufficiently account for future sea-level rise projections. The agriculture and food security sector demonstrated an overreliance on reactive measures, focusing predominantly on resistant crops without systemic support mechanisms like insurance or subsidies, and notably omitted any mention of soil health degradation. Furthermore, agricultural adaptation strategies were compromised by their reliance on outdated yield data (62% from pre-2000, as cited by WB 2019) [47], which skewed coastal zone priorities. In forestry and biodiversity, community-based forest management proved weak due to a lack of enforcement for afforestation projects, alongside the absence of clear funding or monitoring plans for mangrove restoration. The health sector lacked a comprehensive climate-health action plan, with insufficient preventive healthcare infrastructure and budget allocation for climate-related health emergencies. Urban infrastructure exhibited a missing component for urban resilience, with no guidelines for climate-proofing infrastructure, and industries were not mandated to adopt climate-resilient practices. Significant gender inequality in adaptation was evident, as women's roles were acknowledged but not supported by targeted programs, and no livelihood diversification plans were in place for climate-affected farmers or fishers. Finally, the absence of formal risk-transfer mechanisms, such as frameworks for crop/asset insurance or public-private partnerships for climate risk financing, left communities highly exposed to climatic shocks.

6.3. Gaps in Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009, while identifying key sectors, often implies rather than explicitly detailing policy weaknesses. The strategy acknowledges that achieving energy efficiency may require costly new technologies and additional financial resources, suggesting a gap in financing and technology transfer policies. Despite promoting investments, the plan highlights the need to study techno-economic, social, and institutional constraints to adoption, indicating a policy gap in addressing these constraints for widespread renewable energy uptake. The strategy emphasizes urgency but suggests a potential gap in specific policies and comprehensive planning for industrial relocation and adaptation measures related to sea-level rise, particularly in the Meghna estuary where complexity in estimation is noted. The plan implies a need to strengthen the integration of climate change considerations across all sectors and levels of governance, suggesting potential gaps in existing climate change mainstreaming policies and coordination mechanisms. A focus on repair and

maintenance in disaster management suggests a need for continuous improvement and investment in preparedness and response infrastructure, as well as community engagement. In the agriculture sector, the plan emphasizes adaptation but lacks specific, detailed strategies for sustainable water management and soil conservation tailored to climate impacts (T2, Page 48), indicating a gap in integrating climate-resilient agricultural practices comprehensively. Although it recognizes importance, the policy does not sufficiently address challenges of irrigation, flood control, and water quality under changing climate conditions in water resources management (T2, Page 48). The policy does not fully cover vulnerabilities of coastal and marine ecosystems, such as mangroves, fisheries, and habitat conservation, which are critical given Bangladesh's extensive coastline (T3, Page 46). Urban areas' vulnerability to flooding, drainage, and health impacts are under-addressed, lacking detailed urban resilience strategies, including climate-proofing infrastructure and urban planning (T4, Page 46). While health impacts are acknowledged, specific policies targeting health system strengthening, disease prevention, and response to climate-sensitive diseases are limited (T2, Page 48). Furthermore, there are gaps in clear responsibilities, coordination mechanisms, and funding strategies to ensure effective policy implementation and institutional frameworks across sectors and local levels (T1, Page 77), with only 24% of BCCSAP's 2016-2020 targets having verified progress reports due to poor monitoring [48]. Finally, the policy largely focuses on national and broad sectoral strategies but lacks detailed regional or local-level action plans (T5, Page 46), which are essential given Bangladesh's diverse climate vulnerabilities.

6.4. Gaps in Climate Change Trust Act, 2010

The Climate Change Trust Act of 2010, while foundational, exhibits several notable gaps that impede its comprehensive effectiveness. Primarily, it lacks clear mechanisms for private sector involvement, despite acknowledging the roles of governmental and non-governmental organizations. Furthermore, the Act does not adequately empower local governments or community-based organizations in critical decision-making or project implementation processes, even though community capacity building is mentioned. Significant deficiencies exist in transparency and accountability, evidenced by limited provisions for auditing and reporting, and a lack of clear public access to information or independent oversight mechanisms. This is substantiated by evidence suggesting that 37% of the Climate Trust Fund was misallocated to non-adaptive infrastructure, such as urban roads, rather than essential climate-resilient initiatives like saline-resistant crops (TI, 2017). Moreover, the Act demonstrates little explicit focus on climate justice, including the crucial aspect of protecting marginalized groups. It also lacks a mandate for periodic scientific review or policy update mechanisms that would allow for adaptation based on evolving climate data. Critically, the Act fails to establish robust mechanisms for ensuring ongoing inter-ministerial coordination, particularly with vital sectors such as energy, infrastructure, or education. While it per-

mits the seeking of international funds, it does not provide a robust strategy for engaging with global platforms like the Green Climate Fund or for facilitating carbon trading. Finally, the Act is primarily administrative in nature, lacking strong enforcement mechanisms or penalties for non-compliance or the misuse of funds.

6.5. Gaps in Bangladesh's Second National Communication (SNC) to the UNFCCC (2012)

Bangladesh's Second National Communication (SNC) to the UNFCCC (2012) highlighted several critical policy and implementation gaps that constrained effective climate action. A significant concern was the energy sector's heavy reliance on fossil fuels, coupled with an inadequate focus on renewable energy transition, compounded by limited local emission factors and an outdated greenhouse gas (GHG) inventory last updated in 2005. In the agriculture sector, high methane emissions from rice cultivation and livestock lacked comprehensive mitigation strategies, with no clear policies to promote low-emission rice varieties or improved manure management. Water resources management suffered from reactive flood and drought responses, without adequate integration of climate scenarios into long-term planning, and relied on outdated flood classifications. Regarding coastal and forest ecosystems, the protection of the Sundarbans conspicuously lacked specific climate adaptation measures for sea-level rise, and no REDD+ (Reducing Emissions from Deforestation and Forest Degradation) strategy was in place despite observable forest cover decline. Urban resilience was compromised by rapid, unplanned urbanization devoid of climate-resilient infrastructure, evident in Dhaka's severe drainage congestion and the absence of zoning laws for flood-prone areas. Furthermore, there was no systemic plan for addressing climate-induced diseases, and existing health facilities demonstrated insufficient capacity to manage outbreak surges. In terms of technology transfer, the country exhibited minimal engagement in Clean Development Mechanism (CDM) projects, with only two registered by 2012, and a notable absence of pilot programs for renewable technologies. Crucially, data and research capabilities were limited, evidenced by sparse climate observation networks (36 stations for an area of 147,570 km^2) and a reliance on global 250km grids due to the lack of local-scale climate models. Finally, pervasive cross-sectoral coordination issues, characterized by siloed ministries and poor inter-agency collaboration, along with a lack of enforcement mechanisms within the BCCSAP, collectively undermined the coherence and effectiveness of national climate efforts.

6.6. Gaps in Bangladesh Climate Change and Gender Action Plan (CCGAP) 2013

The Bangladesh Climate Change and Gender Action Plan (CCGAP) 2013, despite its objectives, exhibits several sector-wise policy gaps. In the crucial areas of food security, social protection, and health, the plan shows limited focus on women's land rights, a lack of comprehensive crop insurance rollout, insufficient integration into existing health systems, and the absence of targeted policy instruments

specifically designed to support the livelihoods of climate-displaced women. Within Comprehensive Disaster Management (CDM), the framework is hindered by inadequate gender-responsive budgeting, low institutional capacity at the local level to facilitate women's participation, a missing robust monitoring and evaluation (M&E) system for gender-specific indicators, and poor coordination among relevant actors. The infrastructure sector, particularly transport systems, largely ignores women's specific needs, further compounded by low female representation in design and monitoring processes, a lack of disaggregated data (e.g., on mobility and transport by gender), and the absence of gender-inclusive procurement policies. Furthermore, there is a weak conceptual linkage between gender and mitigation efforts, resulting in low female access to clean technologies (such as solar and biogas), neglected entrepreneurial opportunities for women in energy-related businesses, and a general lack of gender review in energy policies. Finally, across cross-cutting pillars like research and capacity building, the CCGAP suffers from minimal academic-policy linkages, weak knowledge-sharing mechanisms, and poor stakeholder coordination, with government, academia, and non-governmental organizations often operating in isolated silos.

6.7. Gaps in Bangladesh Climate Fiscal Framework (CFF-2014)

The Bangladesh Climate Fiscal Framework (CFF-2014) exhibits several critical gaps that impede effective climate finance governance. A fundamental issue is the lack of explicit recognition of climate change within the conventional budget frameworks of various ministries, underscoring a systemic disconnect. This is compounded by limited institutional capacity and technical skills essential for developing comprehensive, long-term climate financing plans. Furthermore, there is a notable absence of a robust system for tracking climate-related expenditures across ministries, which compromises transparency and accountability. The insufficient integration of climate strategies into broader national development plans, such as the Medium-Term Budget Framework (MTBF) and the Annual Development Programme (ADP), represents a significant policy coherence deficit. Sector-specific weaknesses are also pronounced, including gaps in climate-resilient water management, crop diversification, and the adoption of eco-friendly farming practices within the Agriculture & Water Resources sectors. Similarly, policies are insufficient for addressing water-logging, flood control, and building resilient urban infrastructure. There is a clear need for stronger policies on coastal erosion, habitat preservation, and eco-restoration, as well as significant gaps in integrating climate risk into disaster preparedness and response systems. Overall, the CFF-2014 is characterized by fragmented policy approaches that lack coherent and coordinated strategies across sectors, undermining integrated climate action.

6.8. Gaps in Climate Public Expenditure and Institutional Review (CPEIR-2014)

The Climate Public Expenditure and Institutional Review (CPEIR-2014) identified several critical weaknesses and gaps within Bangladesh's climate governance

framework. A significant issue is the lack of statistical information below the ministry level, which severely hampers transparency and accountability in environmental actions, indicating systemic deficiencies in data collection and reporting mechanisms. Furthermore, resources are often not allocated efficiently across different sectors, leading to ineffective climate action and a pervasive lack of coherence in climate-related expenditures. Environmental agencies frequently suffer from poor institutional capacity, which adversely affects both the implementation of policies and coordination among various entities. The absence of a cohesive national statement on climate change policy contributes to significant misalignment across different government levels. Moreover, unclear mandates among ministries frequently result in overlaps or critical gaps in responsibilities. Finally, there is insufficient evidence of robust climate-related capacity building and development of expertise, which consequently hinders the effective implementation of climate strategies.

6.9. Gaps in Intended Nationally Determined Contribution (INDC) 2015

The Intended Nationally Determined Contribution (INDC) submitted by Bangladesh in 2015 revealed several critical policy gaps that could hinder its climate objectives. A significant limitation was the lack of robust data for Land Use, Land-Use Change, and Forestry (LULUCF), leading to its exclusion from quantified targets, alongside a continued reliance on outdated methodologies (e.g., IPCC 1996 Guidelines) for assessing emissions from the agriculture and waste sectors. Furthermore, the ambition of its emission reduction targets was constrained; while a 15% reduction by 2030 was proposed, it was conditional upon international support, whereas the unconditional target of 5% was comparatively modest and potentially misaligned with the global 1.5˚C warming limit. Notably, the INDC lacked quantified targets for key sectors such as households, commercial buildings, and non-energy agriculture, despite these areas contributing significantly to emissions, particularly from biomass and methane, with limited specific measures for methane reduction in rice cultivation or livestock. This minimal emission reduction ambition also suggested a potential trade-off with food security. On the adaptation front, an estimated $40 billion was identified as necessary for the period 2015-2030, yet domestic resources were acknowledged as insufficient, and a clear roadmap for accessing international climate finance was absent. Finally, the INDC was hampered by weak Monitoring, Reporting, and Verification (MRV) systems for adaptation projects and suffered from governance overlaps that lacked streamlined coordination mechanisms.

6.10. Country Investment Plan 2017

The Country Investment Plan (CIP) 2017 for Bangladesh was developed to provide a strategic framework for national and international investments, particularly focusing on environmental, forestry, and climate change (EFCC) issues for the period of 2016-2021. Its goal was to address environmental degradation, pollu-

tion, and natural resource management, and to coordinate implementation among stakeholders. However, a significant gap identified in the broader context of Bangladesh's investment plans, including those related to environmental sectors, is the lack of coherence and uncertain overall impacts of investments to improve the management of these critical sectors, particularly when contrasted with the more coherent approach seen in the food-security sector. This suggests a potential gap in a formal, overarching framework explicitly linking EFCC policies to the investments needed to achieve desired results within a given timeframe, which the CIP aimed to rectify. While the CIP intended to identify priority areas and estimate financing, its long-term effectiveness would depend on overcoming systemic challenges related to attracting and efficiently utilizing both domestic and international finance, as well as fostering stronger public-private partnerships, which are common hurdles in major investment plans. Further, given the date, it might not have fully anticipated the evolving complexities of climate finance mechanisms or deeply integrated gender-transformative approaches into its core investment strategies, which have become more prominent in later plans.

6.11. Third National Communication to UNFCCC 2018

Bangladesh's Third National Communication (TNC) to the UNFCCC in 2018 represented a significant step forward from its predecessors, offering a more updated and comprehensive overview of the country's climate change situation, including its greenhouse gas (GHG) inventory, vulnerability assessments, and actions for adaptation and mitigation. This report benefited from increased national capacity and international support, providing a more refined understanding of climate impacts and identifying potential areas for further action. While it highlighted progress in mainstreaming climate issues into national development policies and enhancing reporting levels since the Second National Communication in 2012, common gaps in such national communications, even updated ones, often include the perennial challenge of robust, disaggregated data collection for GHG inventories and impact assessments, particularly at sub-national levels. Furthermore, while identifying measures, the TNC might still have faced limitations in detailing concrete implementation roadmaps, specific financing strategies, and strong enforcement mechanisms for its proposed adaptation and mitigation actions. It also likely continued to grapple with ensuring full cross-sectoral integration and effectively addressing the nuanced complexities of climate-induced human mobility and gender-differentiated impacts with detailed policy solutions.

6.12. Gaps in Bangladesh Delta Plan 2100 (BDP 2100)

The Bangladesh Delta Plan 2100 (BDP 2100), despite its comprehensive aspirations, faces several critical implementation gaps that could undermine its long-term efficacy. A primary concern is the prevalent tendency for sectoral and institutional plans to be short-term and standalone, thereby lacking effective integration into the overarching long-term strategic vision, which risks creating dis-

jointed efforts. Furthermore, there is a discernible weakness in linking monitoring and evaluation (M&E) mechanisms with policy planning, underscoring an urgent need for robust systems that can effectively inform adaptive strategies. Existing baseline studies and knowledge repositories necessitate regular updates and expansion into novel research areas to adequately address emerging climatic and environmental challenges. Significant difficulties persist in formulating policies and investments that appropriately account for the inherent uncertainties of future climate impacts, thereby impeding the development of genuinely resilient and flexible strategies. Moreover, the ambitious long-term scope of the BDP 2100 demands sustained financial commitments and substantial capacity-building efforts, areas where notable gaps often arise. Finally, effectively translating global Sustainable Development Goals (SDGs) and national sectoral targets into coherent long-term strategies that comprehensively integrate climate and environmental risks remains a challenge, compounded by the imperative to explicitly embed social equity and environmental conservation within long-term planning and community participation frameworks.

6.13. Gaps in Mujib Climate Prosperity Plan 2030

The Mujib Climate Prosperity Plan 2030, while forward-looking in its ambitions, exhibits a notable gap concerning equitable energy access, particularly for marginalized populations. Specifically, its predominant focus on grid infrastructure for solar projects has inadvertently led to the neglect of crucial off-grid solutions. This oversight disproportionately affects vulnerable communities residing in remote areas, such as the char islands, who largely remain unconnected to the national grid. Consequently, this strategic omission results in a significant equity deficit in energy provision, hindering comprehensive development and resilience-building efforts in these highly susceptible regions, as highlighted by findings from SREDA in 2022 [49]. Addressing this imbalance is imperative for achieving genuinely inclusive climate prosperity.

The identified gaps across Bangladesh's climate change policies emphasize the critical need for continuous evaluation, adaptability, and inclusivity, underpinned by robust data and effective monitoring. Addressing these gaps requires a holistic and collaborative effort, ensuring that policies are not only robust in design but also responsive to the evolving challenges of climate change and equitable in their impact.

6.14. Gaps in Nationally Determined Contribution Update 2021

The National Adaptation Plan (NAP) 2023, despite its comprehensive scope, identifies several crucial deficiencies that could impede its effectiveness. Notably, the plan acknowledges inherent technical flaws within its approaches to catastrophe preparedness and the integration of smart agricultural practices. To genuinely enhance adaptation efforts and bridge existing knowledge gaps, there is an imperative need for a more robust and explicit strategy dedicated to fostering techno-

logical advancements, alongside substantial investments in research and innovation. Furthermore, a critical equity deficit in funding distribution is apparent, as evidenced by private-sector climate finance reaching less than 5% of women-led agribusinesses, according to a 2023 study by BCAS [50]. This disproportionate allocation underscores a significant challenge in ensuring that adaptation benefits are equitably distributed across all vulnerable segments of society.

7. Conclusions

Bangladesh's journey in confronting climate change has been marked by resilience, innovation, and a profound commitment to sustainable development. The policies implemented over the years, systematically reviewed through a Policy Cycle Analysis framework, reflect a nation grappling with the immediate threats posed by climate change while striving to build a resilient future. The policies, ranging from the Initial National Communication (INC) report in 2002 to the recent National Adaptation Plan (NAP) in 2023, showcase Bangladesh's proactive approach to climate change. These initiatives, led by various government agencies, underscore a commitment to addressing vulnerabilities, enhancing adaptive capacity, and integrating climate considerations into broader development frameworks. However, this comprehensive review has also shed light on critical gaps and challenges. From substantiated data accuracy concerns in emission inventories and documented financial misallocations to the pressing need for more inclusive and evidence-based adaptation strategies, addressing these issues is crucial for the effective implementation and equitable impact of policies. The complexity of climate change requires a nuanced and evolving approach, recognizing that adaptation is an ongoing process that demands continuous learning and adjustment.

The drivers behind Bangladesh's climate change policies, including international commitments, scientific research, and the imperative for sustainable development, are further complicated by the complex interplay of political, economic, and social factors. While policies have evolved in response to these drivers, continuous adaptation and innovation are necessary to navigate the dynamic landscape of climate change, learning from both successes and failures.

Moving forward, Bangladesh's climate policy trajectory necessitates augmented collaboration among governmental and non-governmental entities, alongside the establishment of transparent and robust reporting frameworks, with an unyielding commitment to inclusivity. The successful and equitable dissemination of climate change policies will hinge critically on the systematic integration of gender-responsive strategies, efficient and accountable resource optimization, and targeted technological advancements. Furthermore, future policy directives must incorporate iterative data systems, such as AI-enhanced greenhouse gas inventories; decentralize implementation by leveraging structures like Bangladesh's Union Climate Centers (UCCs); and strategically harness South-South learning, drawing insights from examples like Vietnam's community-based early-warning systems. Critically, without comprehensively addressing institutional fragmentation and

inherent elite biases, even seemingly robust frameworks, such as the National Adaptation Plan (NAP), risk perpetuating and reinforcing existing vulnerabilities. In the face of observed global climate changes, rising sea levels, and an increasing frequency of extreme weather events, the urgency for strategic and impactful climate change policies cannot be overstated. Bangladesh's commitment to a safe, climate-resilient, and prosperous future is evident, and ongoing, evidence-informed efforts will determine the nation's success in navigating this defining global challenge.

Conflicts of Interest

The authors declare no conflicts of interest.

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