

REVIEW ARTICLE

Comparative analysis of livelihood vulnerability and resilience to climate hazards in Bangladesh and China: A systematic review

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Abstract

This study systematically compares livelihood vulnerability and resilience to climate-induced natural hazards in Bangladesh and China, two nations with different socioeconomic systems, governance structures, and climatic exposures. The comparison is justified by their shared exposure to frequent climate disasters, such as floods, droughts, and cyclones, despite contrasting adaptation strategies and institutional responses. Using a systematic literature review guided by the PRISMA framework, this research examines 77 peer-reviewed articles. The analysis focuses on three key dimensions of vulnerability: exposure, sensitivity, and adaptive capacity, using clearly defined indicators and sub-indicators derived from literature. Results show Bangladesh's vulnerabilities are influenced by dependence on agriculture, limited infrastructure, poverty, health risks, and reliance on traditional coping mechanisms. Conversely, China's vulnerabilities arise from ecological degradation, demographic pressures, regional disparities, and rapid urbanization, often addressed through state-led technological and infrastructural adaptation measures. Bangladesh emphasizes community-based responses, while China focuses on large-scale policy measures, disaster-resilient infrastructure, and the integration of climate adaptation into broader development planning. Both countries face ongoing barriers to effective adaptation. This comparative analysis highlights how different development paths and institutional contexts shape livelihood resilience, emphasizing the importance of context-specific adaptation, cross-country learning, and inclusive policy frameworks. (*Afr J Reprod Health 2026; 30 [8]:119-139*).

Keywords : Climate change, natural hazards, vulnerability, adaptation, resilience, health vulnerability

Résumé

Cette étude compare systématiquement la vulnérabilité et la résilience des moyens de subsistance face aux aléas naturels induits par le climat au Bangladesh et en Chine, deux pays aux systèmes socio-économiques, structures de gouvernance et expositions climatiques différents. Cette comparaison se justifie par leur exposition commune à des catastrophes climatiques fréquentes, telles que les inondations, les sécheresses et les cyclones, malgré des stratégies d'adaptation et des réponses institutionnelles contrastées. S'appuyant sur une revue systématique de la littérature guidée par le cadre PRISMA, cette recherche examine 77 articles évalués par des pairs. L'analyse porte sur trois dimensions clés de la vulnérabilité : l'exposition, la sensibilité et la capacité d'adaptation, à l'aide d'indicateurs et de sous-indicateurs clairement définis et issus de la littérature. Les résultats montrent que les vulnérabilités du Bangladesh sont influencées par sa dépendance à l'égard de l'agriculture, ses infrastructures limitées, la pauvreté, les risques sanitaires et le recours à des mécanismes d'adaptation traditionnels. À l'inverse, les vulnérabilités de la Chine découlent de la dégradation écologique, des pressions démographiques, des disparités régionales et de l'urbanisation rapide, souvent prises en compte par des mesures d'adaptation technologiques et infrastructurelles pilotées par l'État. Le Bangladesh privilégie les réponses communautaires, tandis que la Chine se concentre sur des mesures politiques à grande échelle, des infrastructures résilientes aux catastrophes et l'intégration de l'adaptation au changement climatique dans une planification du développement plus large. Les deux pays sont confrontés à des obstacles persistants à une adaptation efficace. Cette analyse comparative met en lumière comment différents modèles de développement et contextes institutionnels façonnent la résilience des moyens de subsistance, soulignant l'importance d'une adaptation adaptée au contexte, de l'apprentissage entre pays et de cadres politiques inclusifs. (*Afr J Reprod Health 2026; 30 [8]: 119-139*).

Keywords: Changement climatique, risques naturels, vulnérabilité, adaptation, résilience, vulnérabilité sanitaire

Introduction

The world is witnessing an upsurge of natural disasters, largely caused by severe impact of climate change.¹ Numerous phenomena, including temperature variations, changing rainfall, rising sea levels, and evidence of more severe weather, are the effects of climate change.² This is extremely detrimental to human lives and livelihoods. From drought to flood, disasters not only pose terrific environmental challenges but also lead to significant social impact on a global scale.^{3,4} There is ample evidence that those countries with a high share of rural population and an intensive dependence on agriculture (i.e., developing countries) are much more vulnerable to climate change.⁵ However, it is important to understand how other areas are facing and responding to this challenge, especially the most vulnerable. This paper examines two climate exposed countries, Bangladesh and China, with contrasting geography, development level and administrative system. The comparison between them offers a unique chance to explore how varying institutional capacity, socio-economic context and adaptation trajectories have determined livelihood vulnerability and resilience. Although they lie on different sides of the political spectrum, neither country is immune to major natural disasters driven by climate change.

Bangladesh is facing great challenges because of the changing climate consequences owing to its special geographic location, complex social economy, increasing population, large areas of poverty, and lack of technical infrastructure.⁶ The sea level is anticipated to increase markedly by 2050 and 2100, and the migration of millions of people could then take place in those periods.⁷ Furthermore, normal temperatures are increasing, with augmented forecasts for 2030 and 2050, mainly as a result of climate change.⁸ The Bangladeshi ranking in this regard is 5th, which indicates its vulnerability in terms of climate.⁹ As a result, the nation experience a series of severe weather events, including floods, cyclones, riverbank erosion, and droughts, which seriously disrupt the lives of its inhabitants.¹⁰ These events pose considerable challenges to residents' way of life.¹¹ Thus, millions of people are affected, and loss of life, crop failure, damage to infrastructure, disruptions in education and healthcare services, food insecurity, water crises, and large-scale

displacement have made people increasingly vulnerable.¹² In contrast, China is seriously threatened by natural disasters such as floods, typhoons and droughts, and the country is 67th among 191 countries in terms of disaster risk from climate change. These incidents drive poverty and destroy infrastructure and the environment.¹³ The health implications are significant, not least because increased temperatures in 2019 were associated with 26,800 deaths, mostly among the elderly.¹⁴ Climate change produces severe economic challenges including rising cost of coastal flooding, food insecurity and water shortages.¹⁵ Already, the country's agriculture is suffering from degraded product quality and fluctuating yield stability, most notably in staple crops such as corn, rice and wheat. Moreover, the fishery industry in the South China Sea is also confronted with threats from depleted biodiversity resulted by over-fishing, pollution and the rising global temperature.¹⁶ Both jobs and exports also are hurt by this decline. Thus, both nations denote highly related yet diverse cases for examining livelihood vulnerability and resilience to climatic hazards. Here, the term livelihood denotes the potentialities and assets (natural, physical, financial, human and social) that are necessary to support a means of living particularly in rural areas. Vulnerability is examined in three complementary domains: exposure (the level of climate hazard), sensitivity (vulnerability of livelihoods) and adaptive capacity (capacity to adapt and overcome). Although the concepts of vulnerability and adaptation are closely related, they differ analytically. Vulnerability is the structural status that defines the extent of exposure and sensitivity of livelihoods to climate hazards whereas adaptation is the strategic action and policy taken to minimize the vulnerability to a position of resilience.^{17,18} In this study, vulnerability is treated as the underlying condition and adaptation as the response mechanism. The purpose of this paper is to analyze the vulnerability and resilience in China and Bangladesh in the context of climate change induced natural disasters. This study investigates how these two countries with different geographical and socio-economic conditions have met the challenges and problems caused by climate change.

The determination is to develop our understanding of the aspects that promote resilience and vulnerability to environmental hazards. A comprehensive review of the literature

demonstrates abundant evidence about the consequences of climate change and possibilities for adaptation. However, comparatively little research focuses on risk, impact and resilience across country contexts in an integrated way. This paper seeks to help fill this gap by taking a comparative lens on Bangladesh and China and providing a new examination of how these two countries confront similar environmental challenges. This study is profound because it has the potential to influence both academic discourse and policy. By contrasting the varying livelihood vulnerability and resilience profiles in Bangladesh and China, this study attempts to facilitate the development of more context-specific and evidence-based disaster management approaches. The results are expected to be relevant for practitioners and decision makers in disaster risk management and climate adaptation as well as international organizations and global partners focused on long-term development and resilient climate growth. This study has been structured in the following manner. Section 2 describes the methodological framework which includes the PRISMA-based systematic review process. Section 3 presents a summary of the primary findings regarding the vulnerability dimensions and adaptation strategies in Bangladesh and China. Section 4 provides a comparative discussion of the similarities and differences between the two countries. Lastly, the policy implications and future research directions are provided in the final Section 5.

Methods

Research design

This study used the PRISMA protocol, an internationally recognized standard for systematic reviews and meta-analyses, to develop the research plan and conduct the literature review.¹⁹ The process consisted of four main stages: identification, screening, eligibility assessment, and inclusion.²⁰ The review process used a 27-item checklist to prevent reporting bias and ensure transparency, reproducibility, and validity. PRISMA was selected because of its structured methodology, reproducibility, and clarity in source selection documentation. The Critical Appraisal Skills Program (CASP) framework was also put on

to assess the quality and reliability of the selected studies.²¹

Eligibility principles: inclusion and exclusion

There were three pre-defined inclusion criteria for selecting articles. First, articles were required to contain explicit mentions of main keywords that described the theme of the study: 'climate change', 'natural disaster', 'livelihood vulnerability', and 'resilience' (with sub-categories including 'adaptation,' and 'coping strategies') when describing relevant research for a geographical region namely 'Bangladesh' and/or China. Second, studies qualified only if they had been published in peer-reviewed academic journals to ensure methodological rigor, standardized research procedures, and analytical comparability within the systematic review framework. This inclusion criterion eliminated non-peer-reviewed types of documents (editorials, opinion pieces, reports and book chapters). Although this criterion restricts the incorporation of grey literature, it strengthens internal validity and ensures consistency and quality control across the selected studies. Future studies could incorporate grey literature, capturing policy reports and local programmatic perspectives. Finally, the review was temporally limited to studies published between January 1, 2005, and December 31, 2024, which included relevance and completeness.

Research protocol development

A comprehensive research protocol was formulated and strictly adhered to, as shown in Table 1. A comprehensive review of the literature published in last 20 years that specifically looked for recent research on livelihood vulnerability and resilience through climate-induced disasters was undertaken. Additional studies published in recent years provided stronger empirical basis for observed trends and adaptation practices. Table 1 outlines the key components of the protocol, including search strings, eligibility criteria, and analytical approaches. The protocol was applied in a systematic review procedure to make it transparent and reproducible. The retrieval records were filtered by phases- identification, title and abstract screening, full-text screening and final selection

according to PRISMA process. The data were extracted and synthesized systematically in the dimensions of exposure, sensitivity and adaptive capacity.

Search strategy and data extraction

A comprehensive and systematic search was carried out using the Web of Science database following PRISMA criteria. The search terms were prepared by the Boolean operators, using thematic as well as geographic terminology including 'climate change', 'natural hazards', 'livelihood vulnerability', 'resilience', 'adaptation', and coping strategies in association with Bangladesh and China. We used the Web of Science database because it includes a wide range of high-impact reviewed scholarly journals. Although this approach may have excluded some context-specific studies or policy documents found in other databases (e.g., Scopus, Google Scholar, or grey literature repositories), it ensured consistency in academic quality. The search was completed in December 2024. Table 2 presents the keyword combinations used.

A structured data extraction process was used to ensure the credibility, transparency and reproducibility of the systematic review. Information such as author affiliation, year of publication, study location, research design, geographical focus, methods and main findings were collected and categorized into livelihood risks, adaptation strategies and issues and challenges. This approach enabled a comprehensive synthesis of livelihood vulnerability and resilience to climate hazards, following the guidelines for systematic literature reviews.²²

Quality assessment and bias resolution

The CASP (2024) framework was used to evaluate the methodological quality of the selected studies²¹. CASP provides a standardized and reliable instrument to assess the excellence of qualitative and quantitative research in systematic reviews.²³ The assessment focused on theoretical accuracy, methodological soundness, sampling sufficiency, analytical reliability and relevancy for practice and policy.²² The study quality was systematically graded with a three-tier system (meets criteria, partially meets criteria, does not meet criteria) to ensure that only high-quality, empirically sound

research was included in the review. Studies that did not fulfill the minimum quality standard were excluded from the final dataset.

Reviewers independently screened studies based on eligibility criteria to reduce bias in the process of review and data extraction. Discrepancies were resolved by discussion and consensus or involvement of a third reviewer if necessary. We attempted to mitigate the publication bias by searching for diverse types of literature such as peer-reviewed articles and grey literature. Moreover, to enhance transparency and objectivity in the process, a standardized data-extraction form led the way, and thematic coding was cross-validated by the research team to address any interpretive bias.

Data analysis and visualization

The synthesis included retrieving, coding, and summarizing qualitative and quantitative results from the studies that met the inclusion criteria. Thematic analysis was used to determine prevailing themes, dimensions of vulnerability (including exposure, sensitivity, adaptive capacity), and adaptation strategies. In case the type of data allowed, numerical data were described qualitatively. Graphs and charts were developed by Microsoft Excel (Data tabulation), Origin Pro 2023 and Vos viewer v1. 6. 16 was implemented to create the bibliometric network visualizations for improving interpretation of findings and mapping knowledge clusters, keyword co-occurrence patterns and research gaps..

Results

Overview of selected studies

Document selection

The document selection process complied with PRISMA guidelines, guaranteeing transparency and traceability. The initial database search provided 4768 publications. Upon screening titles and abstracts, 4169 studies were discarded for being irrelevant to the subject, duplicated or insufficiently informative. In the third step, the eligibility assessment, another 319 publications were discarded, because full texts were not available, there were methodological flaws, or they did not contain keywords relevant to climate change,

natural disasters, and livelihood issues. The remaining 77 publications met all the inclusion criteria and were included in full review. The complete screening process is presented in Figure 1.

Basic information and characteristics

Figure 2 summarizes the chosen works, which form part of this investigation and focus largely on the consequences of a shifting climate, related natural hazards, and disasters in the Bangladeshi context. These literatures mainly study the riverine islands and coastal areas of Bangladesh with a focus on the problems related to flood calamities, riverbank erosion, cyclones and other pertinent phenomena, as they are well in line with the aims of the present study. On the contrary, Figure 3 presents Chinese studies focusing on climate change and its induced natural disasters. These studies were carried out in different parts of China, such as in mountainous area, riparian zone and coastal region. They focus on vulnerability, adaptation strategies and livelihood resilience which are highly relevant to the current study.

Network of concepts

To visualize the relationships among keywords and thematic clusters, a network map was generated via VOS viewer. This co-occurrence analysis highlights the frequency and interconnection of key terms such as ‘climate change, vulnerability, adaptation, and ‘resilience’ across the selected literature (Figure 4).

Factors contributing to livelihood vulnerability

The vulnerability of livelihoods is defined by the level at which people or communities are vulnerable to external shocks (such as disasters or long-term climatic changes). These stressors are environmental, economic and social disruptions. Knowing the drivers of vulnerability is necessary for the development of pragmatic and context-specific adaptation strategies.

Concept and dimension of livelihood vulnerability

Report defines vulnerability to climate change as the degree an asset is prone, sensitive, or unable to adapt to negative impacts of severe weather conditions and climate variability.²⁴ This will

demand a high level of involvement from scholars and policy makers to design efficient adaptation measures. Vulnerability is especially pronounced in least developed countries, characterized by low income and reliance on agriculture, as the UNDP pointed out.²⁵ This condition requires an inquiry into the adaptive competences of communities with inadequate assets. People’s exposure to the impacts of natural risks is growing and now spans social, physical, human and financial as well as other more naturally oriented realms. While the relative occurrence, duration, and frequency of these hazards may vary, so does the exposure. Vulnerability of the livelihoods refers to how a community is able to cope with external shocks in their system. It includes what would be considered as natural, human, social, physical and financial assets which are indicative of a dependence on the socioecological environment.²⁶ However, the key components of livelihood vulnerability are susceptibility, sensitivity and adaptive capacity as shown in Figure 5.

Livelihood vulnerability in Bangladesh: Influencing factors

People of Bangladesh particularly those living at such vulnerable locations like riverine areas and coastal belt are more exposed to the dual challenges of climate change (CC) and its related natural hazards.³ The consequences of these impacts involve both direct, recurrent occurrences and persistent changes in environmental conditions over time. Such changes and progress have become evident over the years in different areas such as safety of livelihood, school infrastructures, biodiversity and eco-balance, water availability, food security, energy supply settlement stability and patterns of migration within communities affected. Under this background, the indicators utilized for our study have been well designed to evaluate livelihood vulnerability of inhabitants to frequently occurring natural hazards. This research discerned the main dimensions (exposure, sensitivity and adaptive capacity), as well as indicators and sub-indicators of vulnerability based on livelihoods through a thorough systematic literature review (Table 3).

The distance of people from water resources influences livelihood vulnerability as has recently been demonstrated.^{27,44}

Table 1: Design of the research protocol

Items	Description
Databases selected	Web of Science
Criteria of publication	Published in peer-reviewed journals
Language	Documents in English
Time duration	From January 2005 to December 2024
Search terms	Climate change, natural disasters, livelihood vulnerability, livelihood resilience, adaptation, and coping strategies: The Bangladesh and China case.
Search fields	Title, abstract, and keywords
Inclusion criteria	Documents present household vulnerability, livelihood resilience, climate change, natural disasters and hazards, and sustainability
Regional focus	Bangladesh and China

Table 2: Search string used in the research

Database	Search string	Retrieval time	Result first search	Result final
Web of Science	TITLE-ABS-KEY ((Climate Change OR Natural Disasters) AND (Livelihood vulnerability OR Impacts) AND (Resilience OR Adaptation OR Coping strategies) AND (China))		3971 (CN)	46
	TITLE-ABS-KEY ((Climate Change OR Natural Disasters) AND (Livelihood vulnerability OR Impacts) AND (Resilience OR Adaptation OR Coping strategies) AND (Bangladesh))	December 2024	797 (BD)	31

Note: CN means China, and BD means Bangladesh.

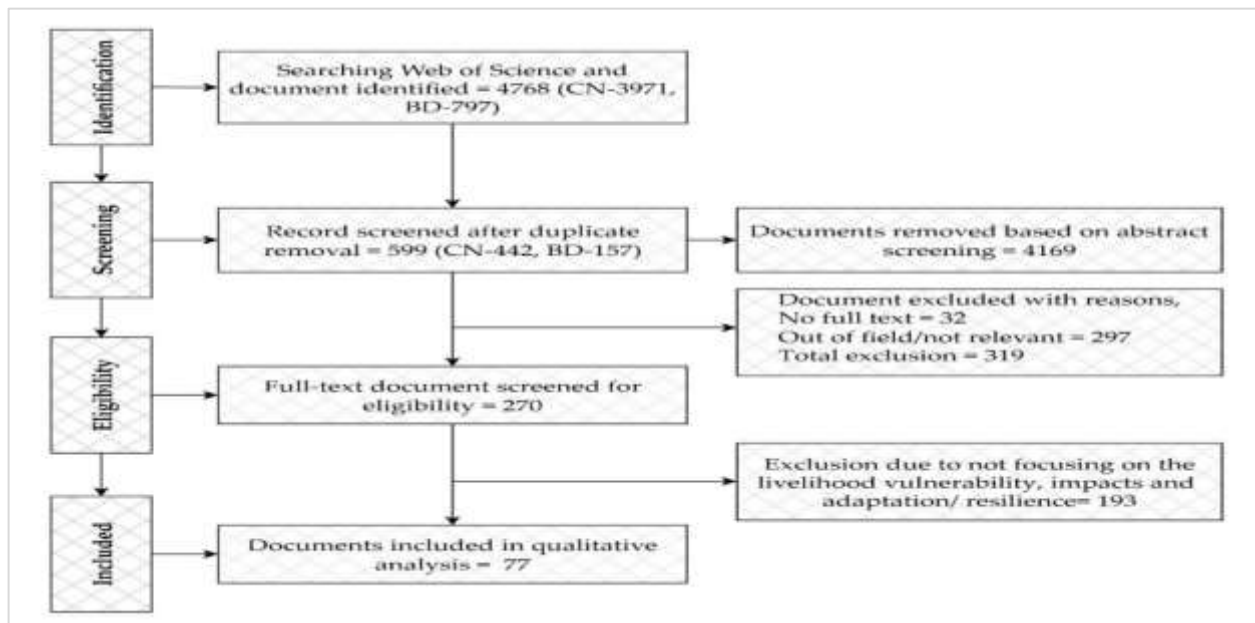


Figure 1: Document selection by PRISMA

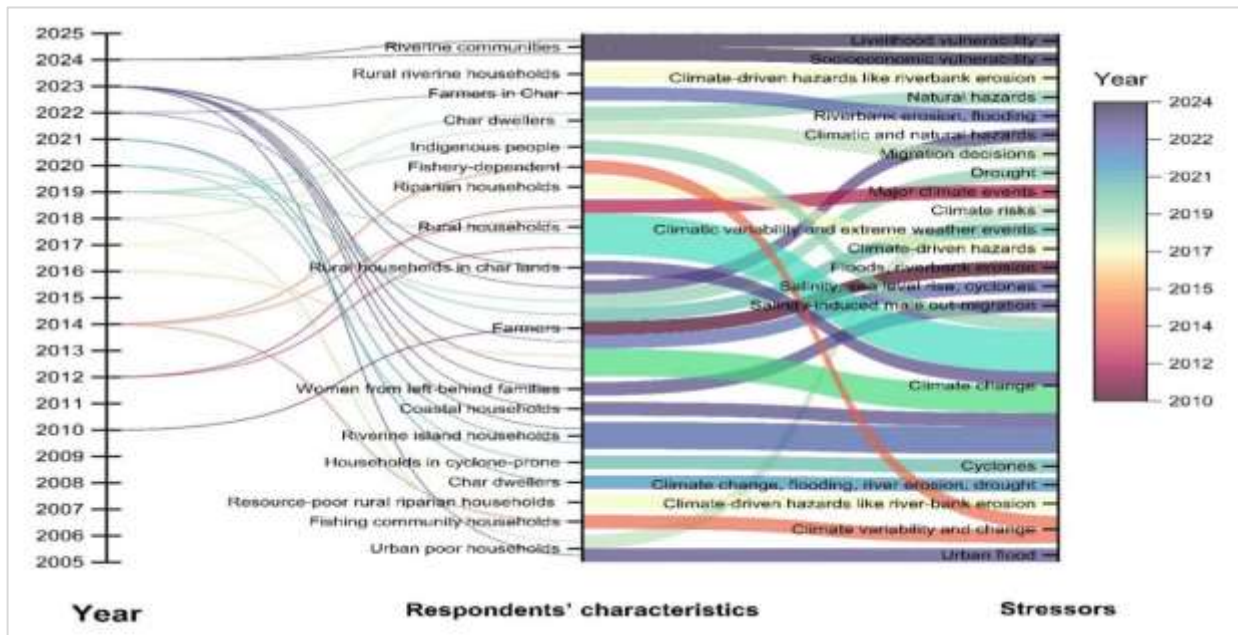


Figure 2: Basic information of the selected articles in the context of Bangladesh

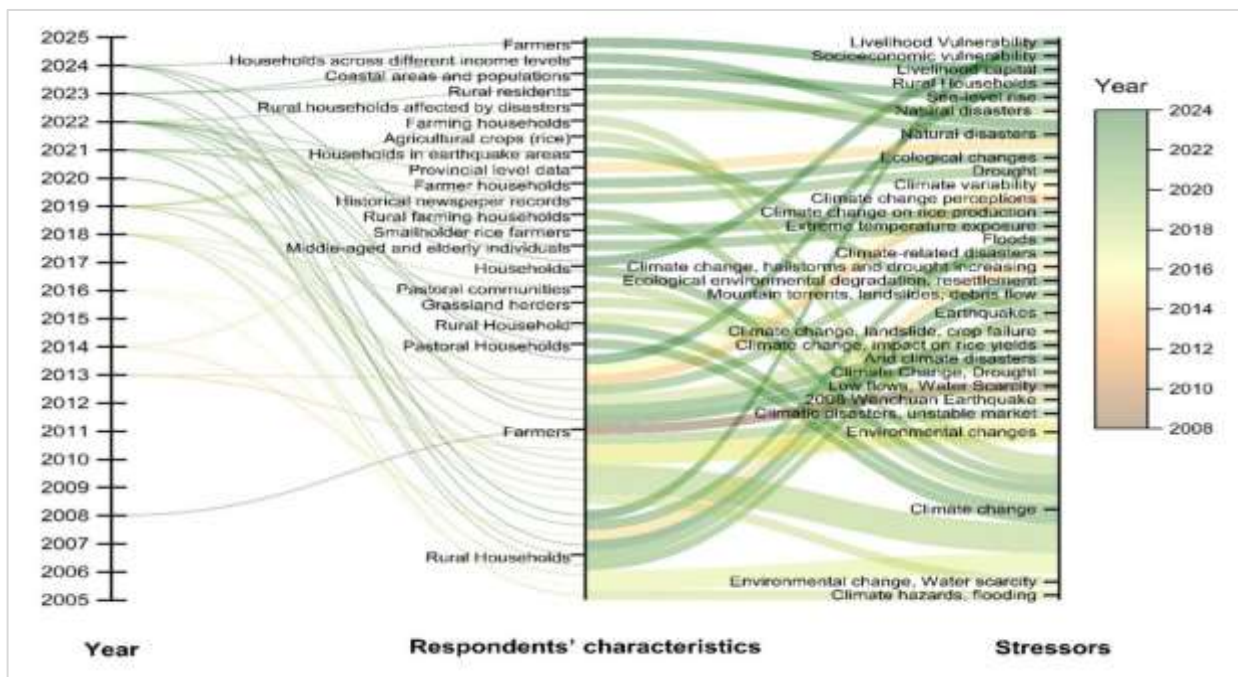


Figure 3: Basic features of the selected articles in the context of China

Hossain stressed that the populations living in vicinity of riverine islands are more vulnerable and exposed to frequent natural disasters.¹ The vulnerability of livelihood in disaster prone area has been influenced by ecological, economic and social factors, mainly for agrarian communities. Level of

education is also an important factor for resilience, and higher level of education has been associated with resilient adaptation. Access to food and drinking water is also important, including in a country like Bangladesh where the intrusion of saltwater is a threat to food security.^{36,45}

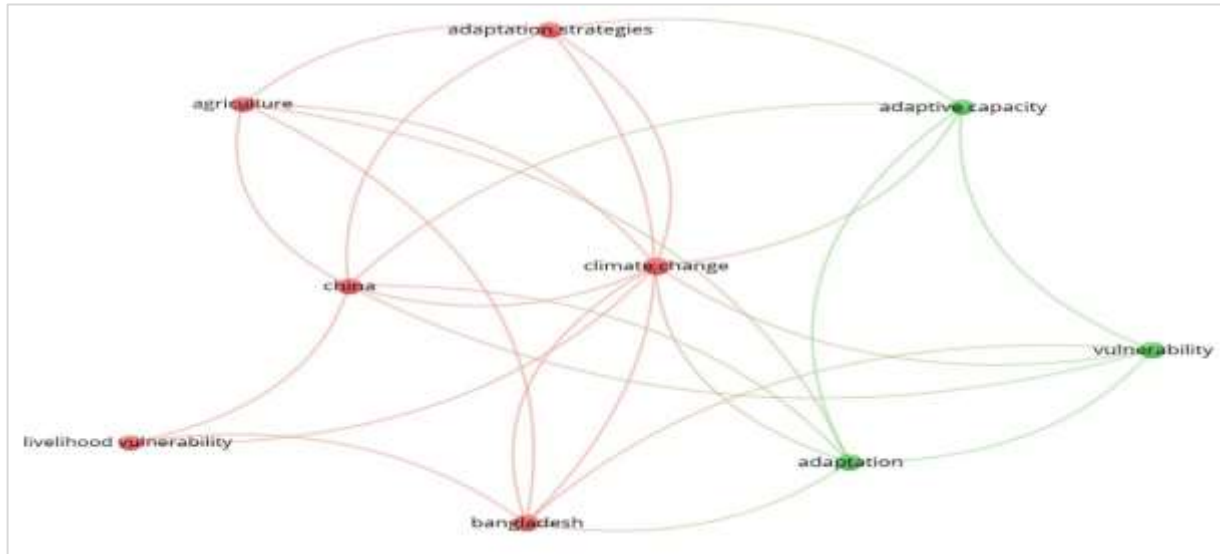


Figure 4: Co-occurrence map of key terms related to climate change resilience.

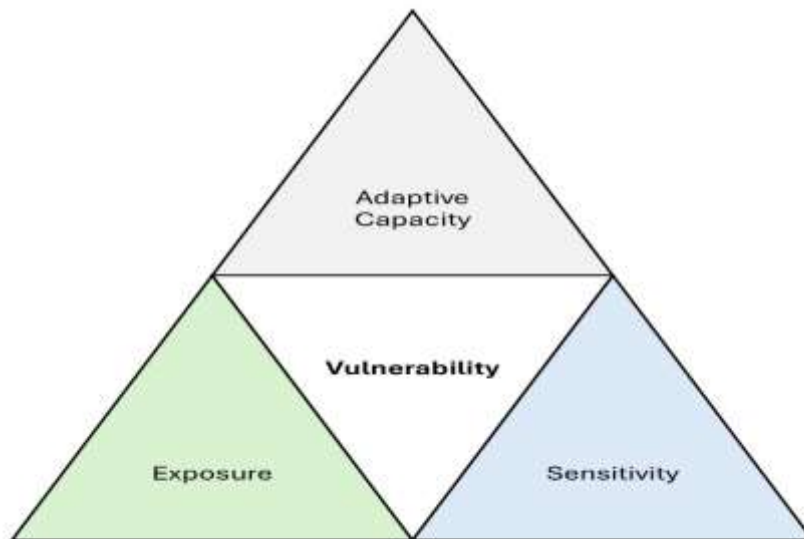


Figure 5: Major livelihood vulnerability analysis component followed by researchers in Bangladesh and China

Agriculture, day labor and fishing are essential for household income, but are particularly sensitive to the effects of climate change with impacts that disproportionately affect marginalized groups.

Factors contributing to livelihood vulnerability in China

China's vast landmass encompasses a diverse array of topographies and climates, hosts various ecosystems, and faces intense population pressures, which have resulted in prolonged human impact disturbances. The geographical location of a region

significantly influences its ecological vulnerability.⁴⁶ The country spans various climatic conditions, from northern boreal to southern tropical climates and from western arid zones to eastern and southern humid climates.⁴⁷ These areas are particularly susceptible to climate change and are adversely impacted by their fragile ecological settings, substandard educational facilities, and deteriorating infrastructure.⁴⁸ Challenges such as food and water scarcity and declining health conditions are prevalent in these regions. Consequently, the capacity of these locales to adapt to climate change is considerably lower than that of more developed

Table 3: Identified indicators and sub-indicators of livelihood vulnerability in Bangladesh.

Main Dimension	Indicators	Sub indicators	Researchers and time
Exposure	Climatic variability	Increased temperature	6,27–34
		Irregular rainfall patterns	
		Sea level rise	
	Natural disaster	Floods, riverine erosion	1,6,27–30,32,33,35–39
		Cyclones and storm surges	
Salinity intrusion			
Hailstorm			
Sensitivity	Socioeconomic factors	Education and awareness	1,6,27–30,32,33,35–39
		Health status	
		Food uncertainty and drinking water	
		Social conflict	
		Lack of employment	
	Agricultural Dependency	Landlessness	1,6,27–30,32,33,35,40–43
		Scarcity of Debt	
		Environmental migrants	
		Crop sensitivity to climate change	
		Reliance on monsoon seasons	
Adaptive Capacity	Infrastructure and services	Quality of housing	1,6,27–30,32,33,35,40–43
		Access to emergency services	
		Road and transportation networks	
	Institutional support	Government policies	
		NGO and community initiatives	
		Disaster preparedness programs	
	Technological capabilities	Early warning systems	
		Climate-resilient agriculture technologies	
		Community networks	
	Social Capital	Local knowledge and practices	
Collective action and cooperation			
Livestock			
Boat			
Rice-husking machine			
Agricultural and non-agricultural assets	Durables (Furniture, one house, motorbikes, vans, bicycles)	1,6,27–30,32,33,35,40–43	
	Taking cash to other people		
	Borrowing money from NGOs		
Income capabilities	Income source during the seasonal time	1,6,27–30,32,33,35,40–43	

Source: Compiled by the authors through an SLR

areas in China. The main indicators that influence the livelihood vulnerability of the population living in China are as follows (Table 4). Table 4 identifies some of the interconnected aspects that make people vulnerable to their livelihoods due to natural calamities and change of climatic conditions especially in the Chinese setting due to the large and diversified geographical location. Different geography of China is prone to climate threats; the eastern part of the country is generally vulnerable to typhoons, and the western part faces the risk of

desertification. This kind of geographic exposure has a major role to play in defining the susceptibility of various communities within the country. Nonetheless, the present study concentrated on livelihood vulnerability to climatic changes and natural calamities on the Chinese side whereby majority of respondents were rural farmer households. A study conducted by Yang and co-workers compared significant differences in vulnerability of agricultural households in different disaster-prone areas.⁵⁹

Table 4: Identified indicators and sub-indicators of livelihood vulnerability in China.

Dimension	Indicator	Sub-Indicators/Examples	Details/Context	Researchers and time
Exposure	Geographical Location	Coastal areas, Flood plains, Earthquake-prone regions	Areas close to seas, rivers, or fault lines are more prone to disasters like floods, typhoons, or earthquakes.	16,46,49–57
	Frequency of Natural Disasters	Historical data on typhoons, floods, droughts	Areas with a history of frequent natural disasters are at higher risk of exposure.	
	Climate Variability	Changes in temperature, Changes in precipitation patterns	Shifts in climate norms can lead to extreme weather events or gradual impacts of climate change.	
Sensitivity	Dependency on Climate-Sensitive Resources	Agriculture, Forestry, Fisheries	Economies reliant on natural resources are more sensitive to climate impacts.	15,16,46,49–55,58
	Socio-Economic Factors	Income sources, Employment in sensitive sectors, Food, Water	Lower income and reliance on vulnerable sectors increase sensitivity, and scarcity of food.	
	Demographic Factors	Age structure, Population density in vulnerable areas, Health status	Elderly, children, and dense populations in high-risk areas are more sensitive.	
Adaptive Capacity	Economic Wealth	GDP per capita, Economic diversity, Access to financial resources	Wealthier areas with diverse economies are better equipped to adapt.	16,46,49–55
	Technology	Availability of technological solutions for adaptation	Access to advanced technology can improve adaptive capacity.	
	Infrastructure	Dams, Flood barriers, Irrigation systems	Robust infrastructure can mitigate impacts of disasters and climate change.	
	Institutional Framework	Government policies, Disaster preparedness, and response systems	Effective governance and preparedness enhance resilience.	
	Human Resources	Education levels, Awareness about climate change, Adaptation skills	Educated and aware communities are better at adapting to changing conditions.	
	Physical asset	Production and daily living assets Livestock number Housing	Stable housing, proper production may help to cope with overwhelming conditions.	
	Social assets	Participating in association organization Social connection	Social relations within the family and outside and involvement in organization can help to recovery.	

Source: Compiled by the authors through an SLR

Adaptation and adjustment strategies to resilience

Livelihood resilience is defined as the ability of individuals or communities to maintain and rebound the livelihood opportunities during disruptions of socioecological, political, and economic dynamics. It includes the actions that support transformation of society and enhance the abilities of the community as stated in the literature.⁶⁰⁻⁶² The sustainable livelihood framework, developed for the alleviation of poverty, provides a way to look at vulnerabilities and how people adapt.⁶³ Central to this approach is recognizing individuals as the focal point, with ecological, social, political, and economic factors shaping livelihood dynamics.⁶⁴ The following tables outline the adaptation and adjustment strategies for responding to the changing climate and natural disasters in Bangladesh and China. Table 5 indicates the survival measures taken by the respondents in Bangladesh against the effects of the changing climate and natural disasters. It underscores a convergence of both traditional and modern meteorological methods such as native methods of prediction and contemporary predictions. These strategies are defined by adaptive housing arrangements, community shelters, profitable ideas based on economic diversification, adaptive agricultural procedures, and anticipation of livestock protection and household management coordination. Furthermore, it also notes the necessity of external support by NGOs and governmental agencies to strengthen local resistance actions.

On the contrary, China has implemented various strategies to manage climate change and natural calamities with consideration of the lengthy and diverse geography and climate of China (Figure 6). This type of resilience is combination of robust government control, community involvement and integration of ancient wisdom with high technology. The construction of sea walls, dikes and Three Gorges dam are large-scale infrastructure projects that are considered large-scale approaches in controlling water resources, floods, and electricity. Furthermore, China is also investing in earthquake resistant infrastructure especially in earthquake prone regions. Moreover, the concept of the sponge city is changing to evolve natural water-absorption and reduce the impact of acute rainfall on urban

localities. China relies on technology in its adaptation strategies such as big data analytics, satellite monitoring, and advanced weather forecasting systems to identify a disaster early and respond promptly. Moreover, the country was keen on the use of renewable energy resources, including solar power and wind power, to reduce carbon emissions and limit global warming.

Problems and challenges in response to natural disasters

Vulnerable and resource poor communities commonly experience huge barriers as a consequence of socioeconomic reasons, lack of knowledge, and shortage of resources which affect their ability to adapt. This paper addresses these obstacles, with a special focusing on Bangladesh and China (Figures 7 and 8). Figure 7 illustrates the barriers to acclimatization measures to changing climate and natural disasters in Bangladesh. Islam (2022) studied the barriers to adaptation of the rice growers in the shoreline region of Bangladesh due to climate change, revealing that barriers were related to financial constraint and lack of proper knowledge for adaption.³¹ Likewise, Hossain et al., (2023) underline that to realize an effective livelihood support, it is important to comprehend these obstacles.¹ As Alemayehu and Bewket, (2017) note, the populations in riverine islands are financially unstable, which contributes to their susceptibility to fluctuations of climate.⁹⁸ Ahmad and Afzal, (2022) also highlight the complexity of the climate adaptation problems, which are supported by past studies.⁹⁹

Figure 8 shows the complexities of adaptation processes to climate change and natural catastrophes in the context of China. Pickson and He (2021) carried out a case study on a group of smallholder farmers in the city of Chengdu and discussed their perceptions, limitations and abilities to adapt to environmental change.¹⁰⁰ The results point to the uncertainty of weather as the main problem that farmers face in responding to climate change. Other major challenges comprise high prices of farming inputs, inadequate water supply, small size of farms, poor labor, and insufficient availability of timely weather predictions. The farmers also cited moderate impediments such as low soil fertility, low access to market, and low credit facilities. Some of

Table 5: Adaptation and adjustment strategies for disaster-affected people in Bangladesh.

Initiatives	Adaptive measure	Researchers and time
Prior to Disasters	Early warning practices	1,28,31,36,37,40,41,43,65-72
	Participation in training in natural calamities	
	Redigging of canal	
	Dry and constant food Reserves	
	Livestock protection	
	Crop production and safeguarding of seeds	
	Use of organic fertilizer	
	Removal of assets	
	Floating garden	
	Tree plantation	
During Disasters	Plantation in highlands	1,28,31,36,37,41,43,65-68,70,71,73
	Wave protection walls	
	Taking shelter	
	Assortment of crisis time's food, monetary aid, and important equipment	
	Securing emergency drug and health amenities	
	Collection of clean drinking water and drug	
	Food routine changes and reducing food feasting.	
Post Disasters	Shifting profession	1,28,31,36,37,41,43,65-67,69-73
	Altering transportation mode	
	Time changes regarding planting and harvesting.	
	Taking loans (NGOs, moneylenders, relatives and neighbor)	
	Housing essentials amenities (GOs and NGOs)	
	Taking income-generating activity (IGA) services	
	Crops diversification and strategies	
	Off-farm engagement (Van, rickshaw, <i>nachimon</i> , <i>korimon</i> and tempo, driver)	
	Seasonal migration	
Treatment receives (Govt. hospital, Quack doctor)		
Smallholding horticultural and Livestock nurture		
Conversion of agricultural land		
Cage aquaculture, net aquaculture		

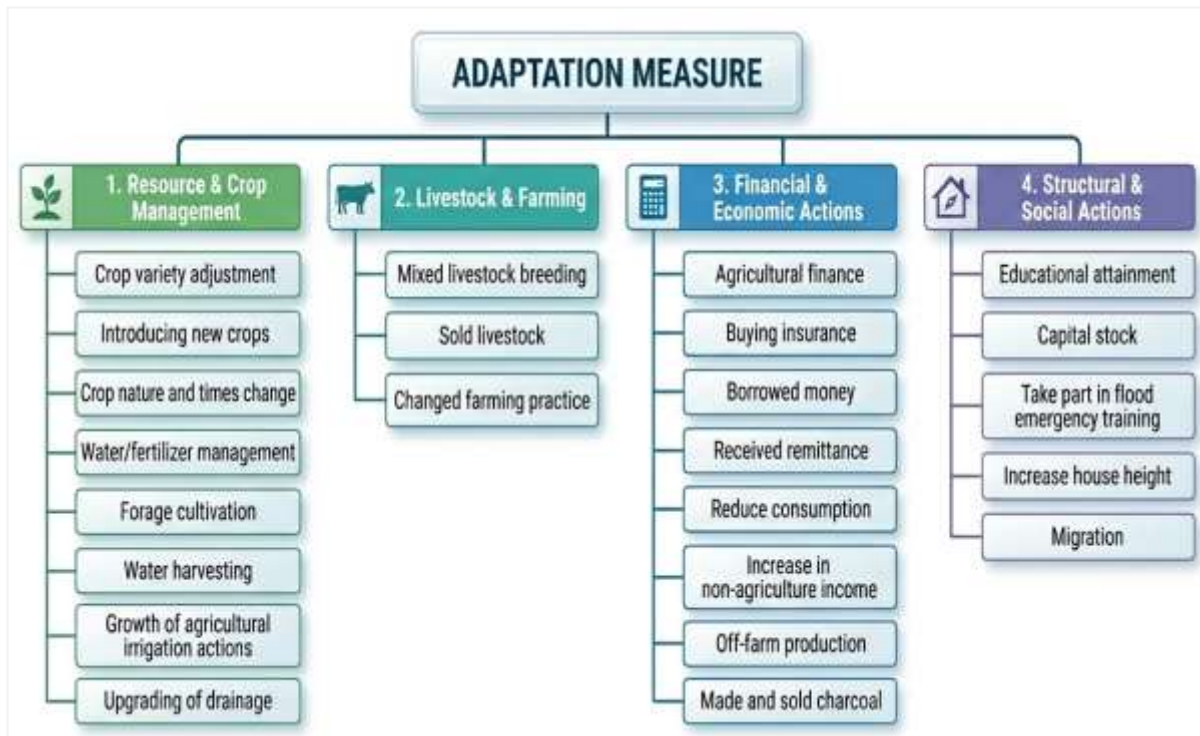


Figure 6: Adaptation and adjustment strategies in China for climate change and ND.

Source: Collected by the authors through an SLR^{16,51-53,74-97}

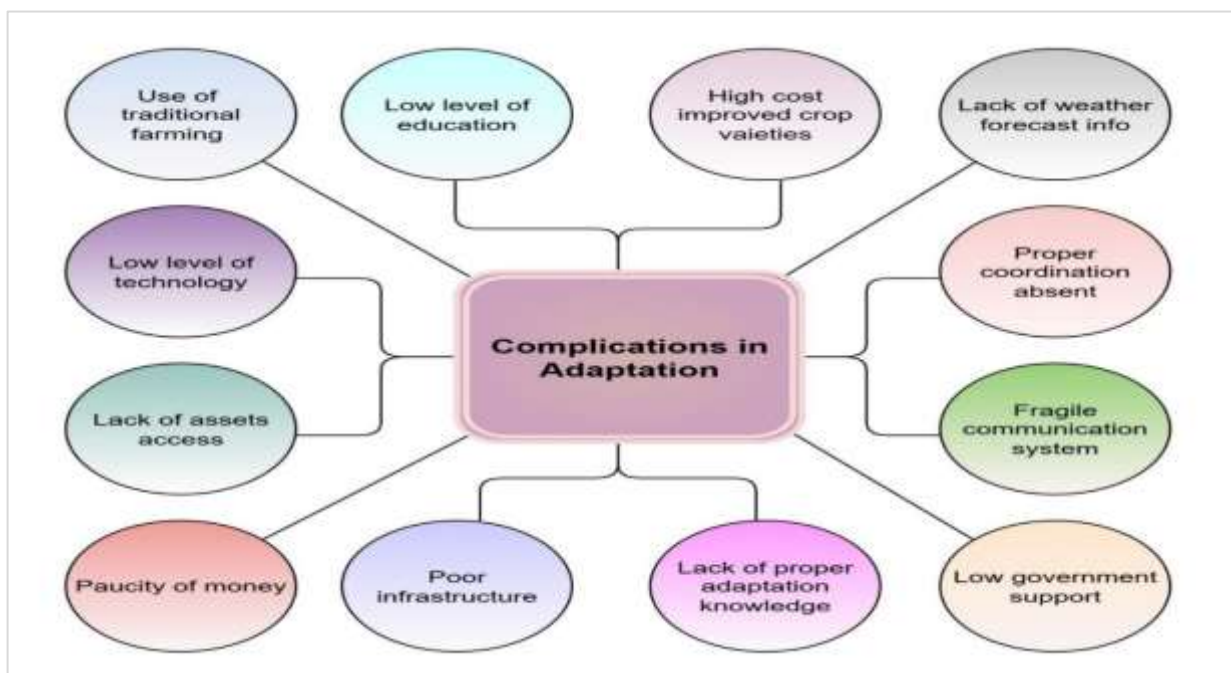


Figure 7: Factor barriers in adaptation strategies to CC and ND from the Bangladesh perspective

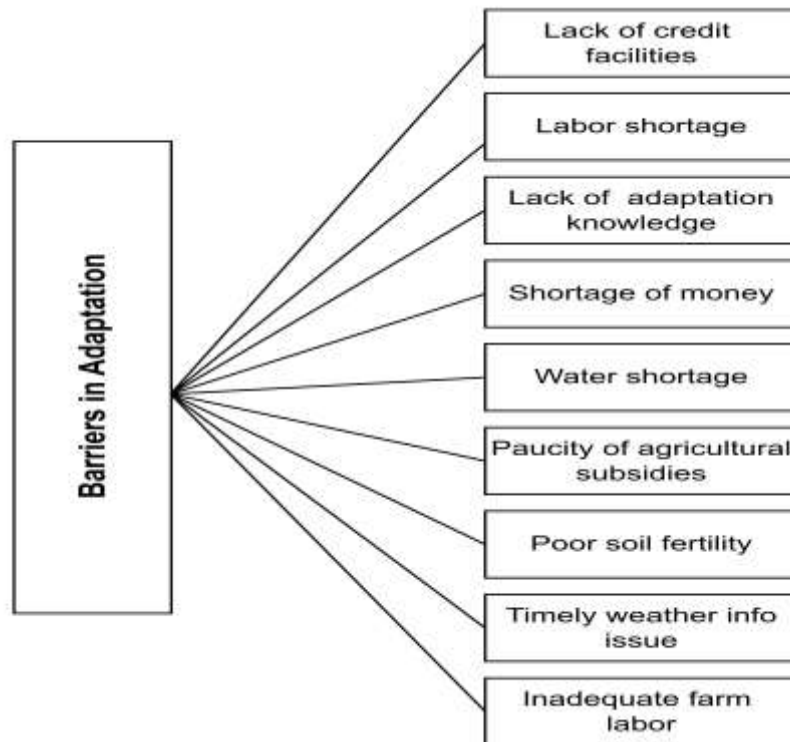


Figure 8: Obstacles to adaptation strategies for CC and ND in China.

the most significant problems were relations with the agricultural extension officers and inadequate farming subsidies.

Discussion

Similarities and differences in livelihood vulnerabilities

Many investigations have been performed to understand and analyze livelihood vulnerabilities to climate change in Bangladesh and China.^{1,27,35,54,72,101} Studies often focus on countries that are heavily dependent on agriculture and have large population densities in sensitive regions, which are negatively affected by variations in climate.^{72,88,102} One common theme running through these studies is the role of adaptive capacity, wealth, infrastructure quality, and the ingenuity of communities. China has an enormous ability to adapt to and mitigate climate change relative to other countries owing to its developed economy and high level of technology.^{87,94} Conversely, Bangladesh displays increased vulnerability due to its insufficient economic capital and dependence on

productivity, which is extremely sensitive to a changing climate^{103,104}. This condition demands the execution of large-scale climate adaptation programs in Bangladesh, which inevitably need international support and investment.

Comparing the vulnerability of livelihoods in Bangladesh and China to natural disasters caused by climate change reveals significant similarities and differences between the two countries. Despite their distinct geographical settings and socioeconomic backgrounds, both countries face comparable challenges. Climate change exacerbates these risks, making them particularly susceptible to weather-related hazards such as storm surges, typhoons, and river floods. Rivers and coastal areas in both countries are exceptionally vulnerable due to their specific geographical features.^{6,105} The agricultural sectors of China and Bangladesh display clear sensitivity to climate variability. In China, regional disparities considerably affect agricultural productivity, whereas Bangladesh's agricultural sector is highly sensitive to saline intrusion. Despite these encounters, both nations have found strong institutional and regulatory frameworks devoted to disaster risk reduction and

adaptation to climate change impacts. These frameworks emphasize the significant role of community-driven initiatives in cultivating resilience, many of which combine traditional knowledge and practices.

However, sensitivity profiles of China and Bangladesh to natural disasters are quite different. China is plagued by various natural disasters, such as typhoons, floods and other forms of flooding, desertification in the north, earthquakes in the west.^{97,106} In Bangladesh, however, the most substantial hazards are cyclones, flooding and the rising sea level.^{12,107} The impacts of these negative events in China vary with respect to depth and spatial distribution.¹⁰⁸ Conversely, under the flat geography of Bangladesh, calamities are always catastrophic.¹⁰⁹

In addition, Bangladesh also has a less capacity to adapt due to its low GDP per capita. This compares with China's much larger GDP, making it more capable of investing in resilience. Moreover, there are important variations between China and Bangladesh in a number of aspects. These factors include quality of government, performance of policy implementation, community involvement and social and human capital. There is also a significant contrast in the quality of infrastructure and access to adaptation/disaster response technology. These differences collectively generate the different strengths and capabilities of the two countries to prepare and deal with the challenges that climate change and natural disasters offer.

Adaptation Strategies: Bangladesh vs. China

Climate change has presented unprecedented challenges to countries worldwide, requiring appropriate adaptation strategies for sustainable livelihoods.¹¹⁰ The communities in this area overwhelmingly choose many adaptation options, which address planned and individual level adaptations to that disaster reducing their adverse impacts. These measures are driven by a range of factors including socioeconomic and environmental circumstances, income, occupation, education and lifestyle.¹ However, this section juxtaposes the acclimatization strategies pursued by Bangladesh and China to natural disasters associated with climate change.

Bangladesh has initiated community-based adaptation (CBA) strategies, leveraging local

knowledge and practices. Agricultural adaptations include flood-resistant and salinity-tolerant crop varieties, which are important for countries where agriculture is the backbone of livelihoods.³⁰ Infrastructure advancements, such as cyclone shelters and embankment fortifications, have been important.¹¹¹ The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) emphasize the country's commitment to incorporating climate resilience into national policies. China's tactic to adapt features extensive technological innovation, evident in its cutting-edge weather forecasting and flood control systems.¹¹² Urban adaptation strategies such as the 'Sponge City' initiative reveal China's commitment to defensible urban development¹¹³. Policy and administration play key roles, as governments actively invest in large-scale infrastructure projects. Additionally, China's attention to green development under the Paris Agreement is consistent with its international commitments.

These two countries have employed strategies that reflect their distinctive socioeconomic and geographical realities, but both aim to lessen the impact of climate change. Bangladesh's importance in CBA replicates its socioeconomic structure, which is highly reliant on local communities and agriculture.⁶⁵ In contrast, China's technological and infrastructural approaches mirror its economic strength and governance style.⁹¹ Thus, both nations clearly disclose the common goal of reducing vulnerability to natural disasters induced by climate change. However, the adaptation approaches noticeably contrast. Bangladesh's tactic is more grassroots and community-focused, while China uses its economic and technological expertise for large-scale, top-down initiatives. Bangladesh confronts economic constraints, limiting the scope of its adaptation strategy. China has more assets but must balance economic growth with sustainable practices. Both countries benefit from international cooperation, knowledge exchange, and technology transfer.

Policy recommendations for Bangladesh and China

Comparative discussion on the livelihood vulnerability and resilience in Bangladesh and China indicates both the similarities and differences in the structural sources of the problems. Though

the factors that contribute to vulnerability in Bangladesh are poverty, reliance on agriculture, and ineffective infrastructure, in China, the causes are ecological degradation, disparities between regions, and urbanization. Policy responses should therefore be context specific and at the same time informed by transferable lessons. On the basis of the outcomes of this analysis, subsequent recommendations are recommended.

For Bangladesh-

- i. Strengthen community-centered governance for disaster risk management. Because Bangladesh's resilience is rooted in community-based adaptation, governance frameworks should prioritize participatory planning and the integration of local knowledge. This emphasis reflects structural conditions such as limited fiscal capacity for large-scale infrastructure, strong NGO engagement in disaster response, and dense rural social networks that support collective coping practices. Risk assessments should be embedded in spatial planning for cyclone-prone rural areas and flood-prone urban settlements, with zoning regulations and climate-resilient housing standards tailored to these contexts. Decentralized early warning systems must be expanded to reach char and coastal populations, which are the most exposed.
- ii. Investment in climate-resilient agriculture and rural livelihoods. Given the high dependence on agriculture and sensitivity to salinity intrusion and irregular rainfall, policies should promote salinity- and flood-tolerant crop varieties, expand agricultural credit, and encourage diversification into non-farm income activities. Collaboration among the government, academia, and NGOs is needed to advance research on low-cost adaptive technologies accessible to smallholders.
- iii. Multilevel policy coordination and international partnerships should be enhanced. To overcome fragmented adaptation initiatives, stronger coordination across ministries and local governments is essential. Bangladesh should deepen its participation in international climate finance and South-South cooperation, leveraging external expertise and resources to supplement its constrained domestic capacity.
- iv. Institutionalize monitoring and learning systems. Continuous monitoring, evaluation, and learning (MEL) mechanisms are required to assess the effectiveness of adaptation programs, ensure

accountability, and build an evidence base for scaling successful community-led initiatives.

For China-

- i. Address regional disparities in adaptive capacity. As findings show, ecological degradation and uneven development increase vulnerability in inland and rural regions. Policies should prioritize investments in ecological restoration, sustainable land management, and poverty alleviation in high-risk provinces to narrow adaptation gaps between urban and rural areas.
- ii. Update and decentralize disaster preparedness frameworks. While China has strong state-led infrastructure and early warning systems, the study highlights limited community engagement. National and local disaster management plans should be revised regularly to integrate scientific advances and lessons learned while devolving authority to empower local actors in preparedness and recovery.
- iii. Resilience should be integrated with urbanization and infrastructure development. Rapid urban growth has increased exposure to climate risks. Urban planning should expand "sponge city" approaches, enforce climate-resilient building codes, and improve drainage and green infrastructure in flood-prone cities. Rural-urban linkages should be strengthened to reduce migration-driven vulnerabilities.
- iv. Renewable and decentralized energy should be promoted for resilience. Building on existing technological capacity, policies should expand solar microgrids and other renewable energy solutions in disaster-prone and remote communities. This not only enhances resilience to energy disruptions but also aligns with China's broader carbon-reduction goals.

Transferable lessons from China to Bangladesh and other developing countries

China has achieved remarkable advancement in terms of institutional, technological and legal constructions, enhancing its ability to mitigate a wide range of natural and man-made disasters. The institutional framework is led by the Ministry of Emergency Management and governed by the local governments and managed by a broad and far-reaching legal framework concerned with prevention, mitigation, response and recovery

activities in the event of floods, earthquakes and other disasters. China has invested much in the technological aspect of disaster monitoring and assessment through satellite technology, the geographic information system (GISs) and early warning systems. Disaster preparedness towards the citizens is enhanced through public education campaigns. China actively participates in international disaster management programs, exchanging good experience and offering valuable information to other nations, particularly the developing countries like Bangladesh, to empower themselves in disasters management.

i. Integrating climate goals with a national strategy: Bangladesh could benefit from emulating China's strategy of building climate objectives into its broader national plans. The strategy includes long-term planning that aims to simultaneously increase living standards, protect the environment and increase economic progress.

ii. Robust emergency management systems: Due to Bangladesh's obvious exposure to natural disasters, especially in coastal and urban areas, it can adopt China's state-of-the-art emergency management framework. With its sophisticated warning system and educational program, the system can be shaped to meet the unique needs of Bangladesh.

iii. Adaptation to local contexts: While China's low-carbon development approach fits its sociopolitical context, Bangladesh can learn valuable lessons from how China aligns national policies with broader economic and environmental goals. This includes prioritizing the development of air quality, renewable energy and green technologies.

iv. Balancing economic growth and environmental objectives: The experiences of both countries illustrate the difficulty of balancing environmental sustainability with economic growth. Bangladesh can learn from China's strategy to sustain financial stability and growth by transitioning to a low-carbon economy.

Conclusion

This paper presents the comparative case of livelihood vulnerability, resilience, and their interactions in terms of natural disasters in Bangladesh and China based on the geographical and socio-economic differences. Vulnerability and resilience inclusion offers a comprehensive insight into community adaptation to climate-based

exposure that guides national and regional policies in Bangladesh and China. The vulnerability in Bangladesh is largely based on agricultural reliance, health issues, food and water deficiencies, weak livelihoods, inadequate technological potential, and financial reliance as well as education disparities. Conversely, the geographical exposure, climate variability, environmental degradation, swift urbanization, social-economic inequality, community awareness, and education are the vulnerability factors in China. Bangladesh adaptation strategies incorporate both traditional knowledge and modern methods to enhance both community resilience and grassroots methods, whereas China uses robust government regulation and technological advancement in large-scale projects. Nevertheless, despite the different circumstances, the two countries are experiencing almost similar challenges but adopt different approaches based on their socioeconomic and ecological conditions.

This comparative analysis demonstrates that Bangladesh's adaptation pathway is largely community-based and livelihood-centered, shaped by resource constraints and strong local social networks, whereas China's approach is predominantly state-led and infrastructure-intensive, supported by greater institutional and technological capacity. These structural differences underline the importance of context-specific resilience strategies rather than uniform adaptation models.

Nevertheless, the results of this study have universal implications that offer adaptability to others experiencing similar challenges. This study fills a large research gap by facilitating the bilateral exchange of information between Bangladesh and China and enhancing international discourse. The focus on livelihoods attracts the attention of highly defenseless groups and stresses the human dimension of the shifting climate effects. In addition to theoretical discussion, this study has enabled international cooperation, policy creation, and humanitarian intervention to deal with the complicated problems posed by climate change.

The research's dependence on secondary data and a literature review may overlook existing records, while its aim on China and Bangladesh confines generalizability. Variability in data quality precludes accurate comparative analysis, and limitations of available studies may exclude recent

innovations. As a result, policy recommendations may sometimes not reflect recent developments, and different conditions limit the extrapolation of lessons. This study proposes longitudinal studies in Bangladesh and China to analyze evolving livelihood risk and resilience dynamics by assessing the effectiveness of current adaptation strategies. It advocates expanding research to compare regions facing similar climate challenges, assess policy effectiveness, explore the role of emerging technologies and investigate their impact.

Authors' contributions

BH initiated the study, collected the data, and wrote the manuscript. BH, MNIS, KI, MKS and MSH processed the data and performed the analysis. BH, MNIS, KI, MKS and MSH revised the manuscript. All authors read and approved of the final manuscript.

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