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Quantifying climate-driven migration in Khulna, Bangladesh: A multi-faceted analysis of socio-economic dynamics, educational gaps, and policy imperatives amidst escalating displacement trends

Muhammad Faysal¹, Md Faisal Alam^{2*}, MM Enamul Aziz³, Md Rasel-Ud Jaman⁴

ABSTRACT

A mixed-methods strategy is utilized in this study to analyze climate-induced migration in Khulna, Bangladesh. Climate-induced migration displace 7.1 million Bangladeshi migrants in 2022, with a projected increase to 13.3 million by 2050 when social and economic vulnerabilities are driving migration, particularly affecting marginalized groups. In this article, 300 individuals are surveyed in Khulna's urban slums where the results reveal that 52% lack educational qualifications, leading to conflicts and unsustainable wages. Vocational shifts to non-skilled jobs intensify competition. Correlation analysis suggests a marginally positive association (.043) between education and income, emphasizing the impact of education on earnings. Severe climatic events like Cyclones AILA and SIDR drive migration, leaving migrants vulnerable with limited assets, education, and urban infrastructure support. Urgent policy interventions are needed to address these challenges, supporting vulnerable populations, enhancing education, strengthening social networks, and improving urban infrastructure to mitigate climate-induced migration's adverse impacts.

Keywords: Climate-induced migration, Vulnerability, Urban infrastructure, Educational attainment, Socioeconomic impacts

1. INTRODUCTION

Climate migration is becoming increasingly interconnected with environmental factors, particularly the escalating impact of climate change. Nexus of the Migration is significant both in Bangladesh and the world, notably in the large

South-West coastal region (Roy et al., 2022). Projections by the International Organization for Migration (IOM) signal an alarming estimate, foreseeing that by 2050, as many as 13.3 million Bangladeshi migrants could be compelled to abandon their homes due to climate-induced circumstances. Remarkably, in 2022, over 7.1 million Bangladeshis had already experienced displacement for climate-related influences, a substantial figure considering the country's approximate population of 168 million.

The delineation of migrant qualifications, the nature of migration itself, and its potential contribution to adaptation emerge as intricate and foreseeable concerns in the discourse on migration and adaptation. Migration dynamics typically stem from the social, economic, and ideological drivers. Instances of crises induced by climate change may prompt affected populations to initiate temporary or permanent relocation to urban centers or regions offering enhanced opportunities. It remains imperative to acknowledge migration as a multi-layered phenomenon, even when primarily instigated by environmental factors. The exacerbation of situations often arises from additional societal, economic, and ideological catalysts (Walsham, 2010).

Furthermore, the decision-making process concerning migration or settlement is tremendously complex, contingent upon individual-specific, social, and even cultural capabilities to cope with and adapt to climate-related shocks and strains. The vulnerabilities experienced by marginalized groups such as women, children, the elderly, individuals with disabilities, and the profoundly marginalized intricately complicate this decision-making nexus. Consequently, while climate change stands as a prominent influencer of migration, the act of migration itself represents merely one of the numerous plausible responses to environmental changes (Bates, 2002; Myers, 2002; Walsham, 2010).

The conceptualization of Quantifying Climate-Driven Migration

The concept of climate migrants exists alongside that of climate migrants. Mayer, (2011) distinguishes climate migrants as individuals compelled to relocate due to demographic pressures, an inability to cope with worsening livelihood conditions, loss of habitable land due to climate change, and displacement not solely attributed to environmental shifts. Shows documentation on climate migrants displaced from their homes and possessions due to climate alterations, propelling them to seek livelihoods elsewhere. The influences that instigate migration are three broad categories. Firstly, push factors encompass the absence of economic opportunities and restricted access to resources for compelling individuals to depart from their original habitats. Secondly, pull factors involve the availability of employment opportunities, higher wages, political stability, and resource accessibility for attracting migrants to specific destinations.

Lastly, hindering factors include personal, social, communal, and economic constraints, with cultural and governmental policies contributing to push and pull dynamics in migration decisions. Bangladesh, housing over 50 million individuals below the poverty line, confronts significant challenges due to its vulnerable population residing in ecologically and economically fragile regions, notably disaster-prone coastal zones susceptible to cyclones. Migration trends in the country extend beyond rural areas, with urban migration becoming increasingly prevalent. Persistent environmental degradation and climate-induced migration impel people, especially those in vulnerable communities, to seek improved livelihoods and income opportunities elsewhere, thereby exerting additional pressures on urban centres (Afsar, 2003). Pertinent literature on climate-induced migration highlights distinct characteristics observed among affected migrants.

Climate migrants emerge as some of the most vulnerable victims of climate change due to the damage inflicted on their local environments. However, these migrants encounter numerous challenges, including land ownership, food and water security, and limited local employment opportunities. Their already insufficient skills and education further compound their vulnerability. Besides, the lack of job information and guidance exacerbates their circumstances, often driving them toward migration. Bangladesh has historically introduced migration by social, economic, and health factors. Yet, the emergence of climate-induced migration, often termed climate refugees, has gained prominence recently. The escalating impact of severe climatic events such as floods, cyclones, and tidal surges, combined with the gradual effects of climate change such as salinity and river erosion, is responsible for this shift.

These environmental pressures drive many vulnerable individuals, already grappling with extreme poverty, to seek better prospects elsewhere. Their decision to migrate is often a result of enduring hardship, suffering, and an uncertain future. Consequently, climate change-induced migration has recently emerged as a significant facet of Bangladesh's social history. Moreover, recent scholarly investigations have unveiled the concept of 'sensitive periods'. These periods signify times when environmental factors directly and substantially influence the rise of climate-induced migration, significantly impacting societal economic dynamics.

2. METHODOLOGY OF THE STUDY

The research employs a mixed-methods approach encompassing quantitative and qualitative methodologies to explore climate-induced migration in Khulna, Bangladesh. The research article used a structured survey involving 300 individuals residing in urban slums *inclusively* demographics, socio-economic status, educational backgrounds, income levels, reasons for migration, and adaptation strategies to collect quantitative data. Complementary to this, qualitative insights derived from in-depth interviews with migrants, community leaders, officials, and representatives from non-governmental organizations (NGOs) offer nuanced perspectives on challenges faced and adaptation mechanisms employed. The selection of participants involved purposive sampling, targeting affected individuals and key informants.

The analytical framework includes statistical methods such as descriptive analysis, correlation, and inferential techniques, complemented by thematic qualitative analysis. These approaches aim to reveal relationships and narratives that provide valuable insights into climatic migration. Stringent adherence to ethical guidelines ensured confidentiality and voluntary participation in the study. The study highlights the need for caution when generalizing findings to Recognize limitations in the sample size and the possibility of biases. The investigation is firmly grounded in a meticulously constructed conceptual framework derived from an extensive literature review, focusing on vulnerability, adaptation strategies, and socio-economic impacts within the urban slums of Khulna.

3. RESULTS, DISCUSSION, AND FINDINGS

The discourse illuminates Bangladesh's susceptibility to varied natural upheavals, perpetually disrupting coastal lives intensified by the relentless impacts of climate change. This change led to surging disaster losses, fostering distressing climate-induced migration and exacerbating urban poverty. The intricacies of migration intertwine with multifaceted factors, notably pre-migration asset deprivation, and pervasive poverty shaping for this landscape. The study aims to fortify resilience among climatically displaced settled in Khulna's urban slums, employing qualitative insights into adaptive strategies. The research integrates diverse quantitative data and unveils challenges in service-deprived slum settlements, highlighting the enduring plights of climate migrants at Rupsa and Sonadanga in Khulna, Bangladesh and underscoring the protracted struggle of marginalized communities.

The Educational attainment of slum dwellers who have undergone migration

The surge in migration within Khulna city presents formidable challenges for integration into its diverse economic landscape due to a lack of essential educational qualifications. Khulna city, characterized by sluggish economic growth, offers limited opportunities for foreign labourers. Unfortunately, a significant majority of migrants lack the necessary study credentials, which are vital for evaluating human capital. Migration following extreme climatic events often involves individuals with restricted financial, physical, and human capacities, further aggravating their educational deficiencies. Approximately 25% have primary education, 4% hold an SSC qualification, 14% have education below SSC, and 5% have completed HSC education. Notably, 52% of migrants lack of education (Figure 1), leading to conflicts with local communities. The willingness of migrants to accept lower wages contributes to an overall decline in wage levels, pushing the working conditions to unsustainable points, as depicted in the chart.

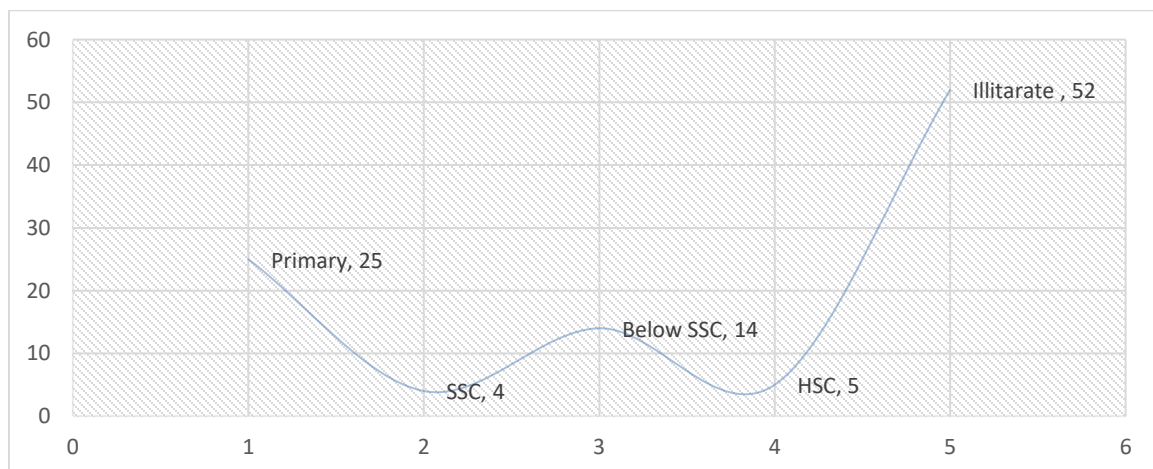


Figure 1 The educational attainment of slum dwellers who have undergone migration in Percentage.

The intricate and critically analyzed vocational pursuits observed among slum dwellers who have undergone migration

Pre-migration most worked in fishing; post-climate events, they relocated to Khulna. Male migrants often become day laborers or rickshaw pullers; females take domestic roles. Others diversify: 15% in agriculture, 15% in small businesses, 43% as daily wage laborers, 4% as housewives, 25% as rickshaw pullers, 4% as students, and 3% as unemployment (Figure 2). Living standards in Khulna declined due to limited capital and inexperience in non-natural resource-based work. Competition for jobs is fierce, given their non-skilled background and unfamiliarity with labor laws. Most of them work in the informal sector, reliant on manual labor, yielding low earnings. The lack of training facilities further hinders employability. Interviews show most migrants struggle to earn 100 BDT per day, grappling with securing stable, well-paying jobs post-migration due to skill mismatches, resorting to limited-earning informal sector work.

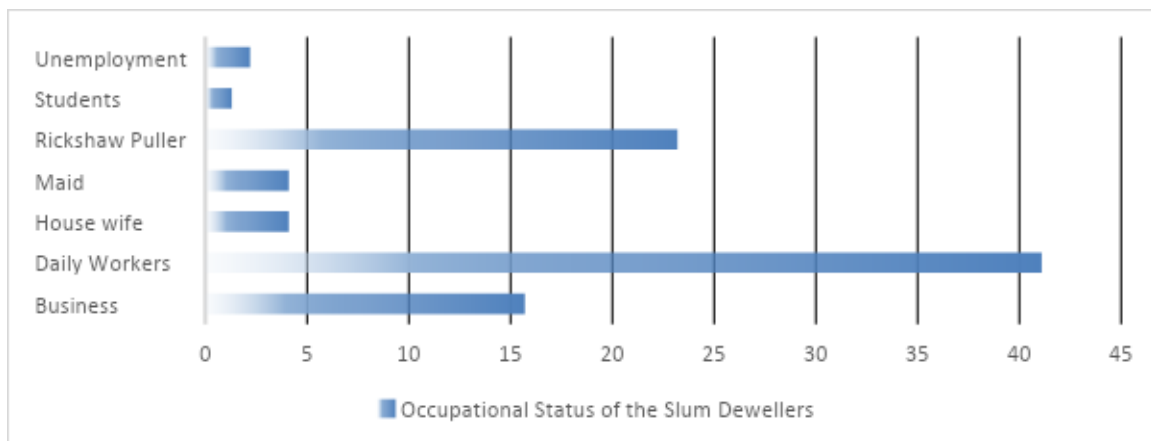


Figure 2 The intricate and critically analyzed vocational pursuits observed among slum dwellers who have undergone migration in percentage.

The socio-economic repertoire of migrated slum dwellers urging them to seek and secure employment prospects

Immediate rehabilitation facilities are crucial for arriving climate migrants. Data analysis shows most initially seek shelter with relatives or fellow citizens, compatriots, villagers, some secure initial jobs with compatriots. Only 17% of slum dwellers possess job-related skills; 83% lack specific skills (Figure 3). Post-migration, climate migrants often opt for non-skilled jobs, notably women who were housewives pre-migration. Due to skill limitations, they take up domestic services or dockyard work. Interviews with these women highlight their employment choices and available job opportunities.

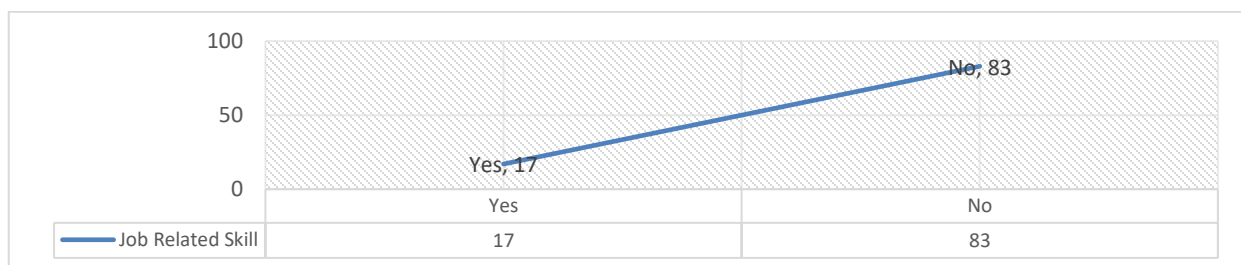


Figure 3 The socio-economic repertoire of migrated slum dwellers urging them to seek and secure employment prospects in Percentage actively

The multifaceted determinants underpinning the phenomenon of climate-induced migration

Individuals from disaster-prone areas migrate to Khulna City driven by various compelling factors. Approximately 5% relocate here seeking access to essential resources. Around 33% are attracted to the city's employment opportunities, while another 33% migrate due to the high labor demand in this region. Additionally, approximately 14% of migrants entice higher wages, while about 9% specifically choose Khulna as their preferred destination (Figure 4).

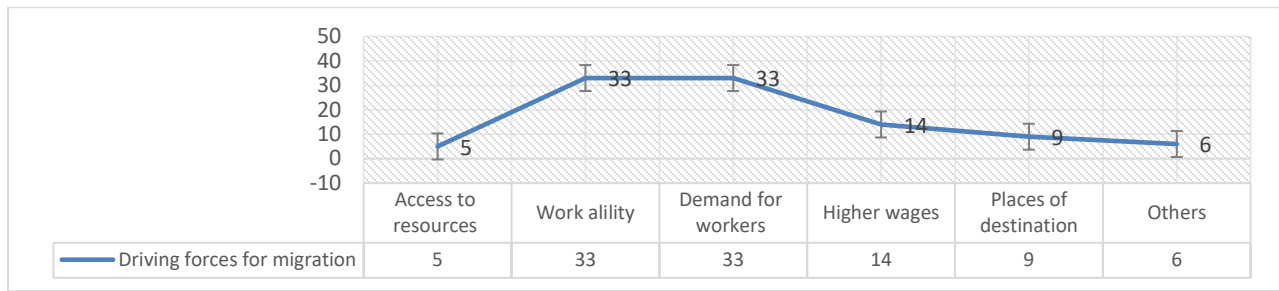


Figure 4 The multifaceted determinants underlying climate-induced migration, represented in percentages.

The intricate and critically assessed financial capital held by climate migrants

In pre-migration, asset ownership significantly influenced climate migrants' migration decisions, signifying family wealth. Assets, categorized into three groups, showcased the migrants' limited human capital due to inadequate education and reliance on natural resource-based livelihoods, limiting adaptability to new environments. The distribution of possessed assets among respondents indicated: 4.5% owned agricultural land, 13.7% had house resources, 1.3% owned cows or vans, 33.1% had land resources, 1.4% owned ponds, 1.3% had domestic animals, and 1.3% engaged in shrimp cultivation. Alarmingly, 23.4% had no resources, emphasizing vulnerability. A mere 7% of migrant families possessed job-specific skills, highlighting the scarcity of adaptable skills pre-migration (Figure 5).

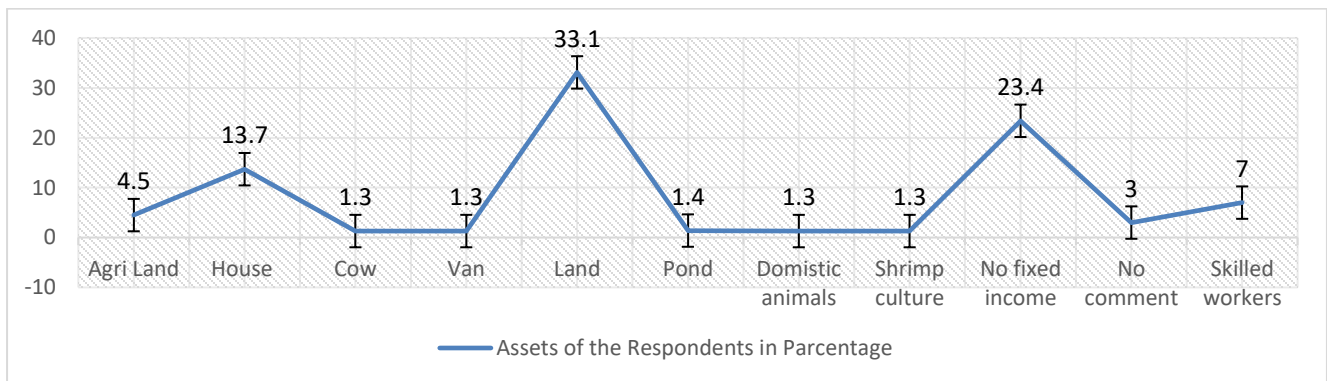


Figure 5 The intricate and critically assessed financial capital held by climate migrants, in Percentage

The multifaceted and critically assessed determinants encompassing both push and pull factors influencing climate-induced migration

Climate-induced migration in Khulna is primarily spurred by severe climatic events, especially cyclones like AILA and SIDR, causing extensive devastation to rural livelihoods and compelling migration. AILA's impact rendered homes uninhabitable, leaving many without means for restoration, prompting migration due to dire circumstances. Roughly half of households migrated due to Cyclone AILA in 2009, while 5% fled inundation threats and 3% due to river erosion. Approximately 7% relocated due to Cyclone SIDR in 2007 (Figure 6). Pre-migration, these migrants possessed robust social capital, fostering bonds with neighbors, engaging in communal resource-sharing of essentials like sustenance and water, and cooperating in domestic tasks.

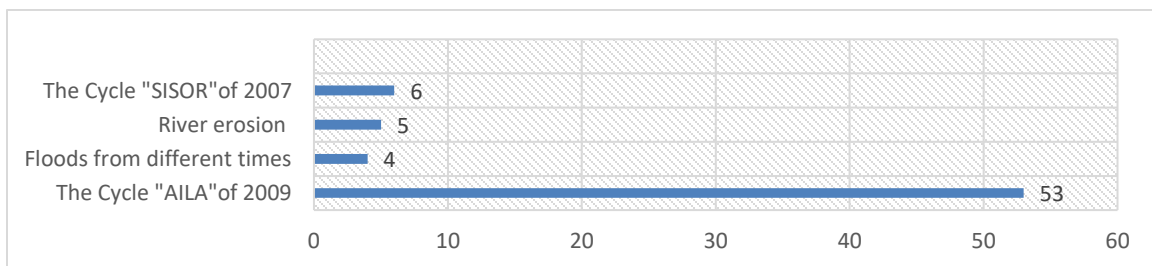


Figure 6 The multifaceted and critically assessed determinants encompassing push and pull factors influencing climate-induced migration.

Table 1 The intricate and critically evaluated interrelations between the educational attainment and income levels of individual migrants

Correlation		Education	Income
Education	Persons Correlation Sig. (2-tailed)	1	.043
	N	39	39
Income	Persons Correlation Sig. (2-tailed)	.043	1
	N	39	39

Table 1 illustrates the correlation analysis between educational attainment and income among individual migrants, revealing a Pearson correlation coefficient of .043 for both variables. The data signifies a marginally positive association between education and income. However, the correlation falls within a relatively weak range, suggesting a limited strength of association. The correlation values and significance levels for education and income are identical, indicating a mutual relationship between these variables. Yet, caution warrants due to the small sample size of 39 respondents for education and income data. Generalizing these findings to larger populations requires prudence, given potential limitations in statistical power due to the modest sample size.

Further research with larger groups is necessary for more comprehensive insights. Additionally, the study highlights the pivotal role of reciprocal social ties in mitigating vulnerability to climatic adversities for migrants. However, the sustainability of these ties was contingent upon the abundance of their capital assets. The impact of events like Cyclone AILA led to community impoverishment by affecting mutual support significantly. While the correlation value remains below the typically considered thresholds (.3 or .7), there is a discernible moderate relationship between education and income among respondents. As educational quality improves, there is a corresponding increase in reported income levels among the respondents.

The complex and critically scrutinized nexus between educational disadvantage and financial challenges in the context of climate-induced migration

The research delves deeply into climate-induced migration in Khulna City, Bangladesh, emphasizing the intricate interplay between environmental factors, particularly climate change, and resultant migration patterns. It projects alarming estimations, suggesting that by 2050, around 13.3 million Bangladeshis may confront displacement due to climate-related factors, with over 7.1 million already displaced in 2022, signaling the urgency and significant societal impact. After exploring migration decisions influenced by a convergence of socio-economic and ideological factors amidst climate-induced scenarios, the research uncovers the complexities of migration dynamics. The vulnerabilities of several demographic groups—women, children, elderly, and those with disabilities—highlight their combined challenges in the face of climatic adversity. The migration surge in Khulna city emphasizes the struggles of climate migrants in adapting to an unfamiliar economic landscape.

Limited educational attainment poses a substantial barrier to adaptation is evident in the prevalence of non-skilled job pursuits among migrants in diverse sectors post-migration. Moreover, the vulnerability of migrants manifested through limited assets and literary qualifications poses significant hurdles in securing stable livelihoods and exacerbate the lack of job information, training facilities, and guidance. Correlation analysis indicates a marginally positive association (.043) between educational attainment and income among migrants, suggesting the potential impact of educational improvements on income levels. The research highlights migration trends toward urban areas due to climate-induced hardships, primarily river erosion and natural calamities.

However, educational deficits (78%) and involvement in the informal labor sector (82.5%) contribute to economic precocity among migrants, exacerbated by a lack of training opportunities (37%). Social networks, which are vital for migrants' support, are facing challenges for urbanization, potentially threatening their longevity amidst spatial displacement. The grim realities faced by migrants—water (45%) and food (37%) insecurity and inadequate healthcare access (32%)—underscore profound challenges within urban infrastructure. Finally, this research underscores the need for nuanced policy interventions to support vulnerable populations, enhance educational opportunities, strengthen social networks, and address critical gaps in urban infrastructure to effectively mitigate the adverse impacts of climate-induced migration in Khulna City.

4. CONCLUSION

The research underscores the intricate interplay between climate-induced migration and socioeconomic vulnerabilities, emphasizing the urgent need for targeted policies and interventions. Highlighting the plight of climate migrants in Khulna city, the study reveals challenges stemming from limited educational qualifications, employment disparities, and inadequate infrastructure. Correlation analysis indicates a marginally positive association between education and income among migrants, suggesting the

potential influence of educational enhancements. Urgent action is imperative to address migration challenges, strengthen educational opportunities, fortify social networks, and bolster urban infrastructure. This research advocates for nuanced policy frameworks to mitigate the adverse impacts of climate-induced migration, fostering resilience among vulnerable populations in Khulna.

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Authors' Contributions

Muhammad Faysal: Conceptualization of the study, defining research objectives and scope, conducting field surveys and data collection in Khulna's urban slums, analysis and interpretation of quantitative data related to socio-economic vulnerabilities and educational gaps and contributed to the writing and editing of the manuscript.

Md Faisal Alam: Collaborated in refining the study's focus and methodology, involved in the literature review and theoretical framework development, conducted statistical analysis and correlation assessments between education and income, contributed significantly to the manuscript drafting and revision process.

MM Enamul Aziz: Provided expertise in sociological perspectives and conceptual frameworks, assisted in the interpretation of qualitative data obtained from interviews, contributed to the discussion section, emphasizing policy implications and recommendations and reviewed and provided critical input for the manuscript's finalization.

Md Rasel-Ud Jaman: Contributed to the design and implementation of the research methodology, conducted interviews and gathered qualitative data on migration drivers and challenges, engaged in data analysis and provided valuable insights into urban infrastructure challenges and assisted in manuscript preparation and contributed to the conclusions and recommendations.

The authors collectively contributed to the entire research process, from the conceptualization and data collection to the analysis, interpretation, and manuscript preparation, ensuring a comprehensive and multifaceted examination of climate-induced migration in Khulna, Bangladesh.

Disclosures

The authors declare no conflicts of interest related to the research, including financial, personal, or professional affiliations, that could potentially influence or bias the outcomes, analysis, or interpretation of the research findings presented in this publication. This research was conducted with full transparency and adherence to ethical standards.

Ethical approval

Not applicable.

Informed consent

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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