SN Soc Sci (2024) 4:64
https://doi.org/10.1007/s43545-024-00864-2

REVIEW PAPER

The links between climate change and migration: a review of South Asian experiences

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Received: 16 March 2023 / Accepted: 17 February 2024 / Published online: 26 February 2024

Abstract

Migration, or human movement from one place to another, is nothing new. Numerous studies have found that, due to climate change and various extreme weather events, relocation to other places is increasing, and experts often say that these events will have a significant impact on human migration in the future, especially in South Asia. This article comprehensively reviews the literature on climate change and migration in South Asian countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka) published between 2000–2023. Based on this review we create a typology that we call "Multilayered or Integrated Climate-Induced Migration" (MICIM) and explain the link between climate change and migration in South Asian countries through three possible pathways. First, temporary migration is seen as a livelihood-diversification strategy, with reliance on temporary migration increasing during extreme weather occurrences or other times of environmental change. Second, when agricultural productivity drops due to climate change or other weather occurrences, people often move to new areas as a means of protecting themselves from food/water insecurity. Finally, we found that in South Asian countries, extreme climatic events such as floods, cyclones, etc., resulted in forced relocation. Importantly, we also found that existing social inequality plays a significant role in migration decisions in South Asian countries. Accordingly, migration is not an equally viable option for all groups, even if they face climate vulnerabilities. Further research, as well as adaptation plans, are required for these "trapped populations". We identified some gaps in the existing literature and suggest that further investigation, using a more intersectional lens, should be undertaken in order to more comprehensively, context-specifically and comparatively, explore the relationships between climate change and migration. Furthermore, there is a need to generate improved employment opportunities and livelihood options in South Asian nations, particularly in times of natural calamities such as floods, droughts, cyclones, and similar

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occurrences, especially for those who are unable to migrate to other places due to lack of resources.

Keywords Climate change · Displacement · Insecurity · Migration · South Asia

Background and introduction

Human relocation from one place to another is nothing new. Although many social, economic, demographic, and ecological considerations have a role in the ultimate decision to relocate, migration as a response to environmental changes is also a historical phenomenon (Hunter et al. 2015; Jha et al. 2017; McLeman and Gemenne 2018). Black et al. (2011a) identified several drivers of migration that incorporate environmental, social, economic, demographic, and political variables. Numerous scholarly investigations have explored the connections between climatic change and human migration and settlement in prehistoric times (Huntley 1999; Tyson et al. 2002). Several researchers, including Warner (2010), Renaud et al. (2007), Conisbee and Simms (2003) and Adamo (2010), assume that people relocate because they are unable to adapt to their current surroundings. Moreover, as early as 1990, the Intergovernmental Panel on Climate Change (IPCC) made the observation that the greatest single impact of climate change might be on human migration because millions of people could be forced to relocate as a result of shoreline erosion, coastal flooding, and agricultural disruption (Lonergan 1998).

People in the South Asian region are increasingly concerned about climate change and climatic variability (ADB 2010; Sivakumar and Stefanski 2011; Turner and Annamalai 2012). River deltas, semi-arid lands, and glacier-dependent basins, where over 1 billion people live, are climate-change hotspots in the region (Hans et al. 2021). The prevalence of smallholder farmers, who, on average, have access to less than 0.1 ha of arable land per person (FAO 2013), and the region's projected increase in the frequency of climatic extremes such as floods, droughts, cyclones, heat and cold waves, and storms (Lal 2003; Bhattacharyya and Werz 2012) explain this concern. The major effects of climate change include worsening weather extremes, rising sea levels, changes in water availability, and environmental destruction. These shifts are major contributors to migration, whether temporary or permanent, because of the loss of climate-sensitive occupations and lack of adaptive capacity in many South Asian nations (Deshingkar and Start 2003; Deshingkar and Akter 2009; Kumar and Viswanathan 2012; Bhatta et al. 2016). Furthermore, environmental factors also indirectly influence human migration decisions because of their impact on economic activity, a loss of agricultural output and increased expenditures resulting from rising food prices (Porter et al. 2014). The estimated internal climate-induced migration in South Asia by 2050 ranges from 16.9 to 40.5 million, depending on the scenario (Rigaud et al. 2018).

South Asians have been dealing with and adjusting to local circumstances for a long time, including multiple stressors and shocks, climatic and otherwise (Ojha et al. 2014). Living in environmentally vulnerable areas, people are accustomed to adopting diverse coping and adaptation strategies for their survival, and migration is

one of the ways that individuals can adjust to environmental changes (McLeman and Hunter 2010). Coping strategies are unplanned reactions to extreme events, with the majority emerging from local survival strategies (Osbahr et al. 2008). On the other hand, adaptation strategies are frequently planned for longer-term actions to adjust to climatic variability (Ravera et al. 2011). In this context, migration is frequently viewed as a method of coping with rapid-onset disasters (Etzold et al. 2014) and a form of adaptation to climate change (Ahmed et al. 2012; Kumar and Viswanathan 2012; Brockhaus et al. 2013). However, given the wide variety of other factors that can influence decisions to move, including economic, political, social, and demographic factors, it is unusual to encounter people who are relocating exclusively due to climate change (Black et al. 2011; Abu et al. 2014; Cattaneo et al. 2019). The decision also varies depending on a household's makeup and the strength of its social networks (Hunter et al. 2015).

Neoclassical theory and the New Economics of Labor Migration (NELM) theory are two notable approaches to exploring the various factors that lead to migration. The neoclassical theory emphasizes the economic costs and benefits of migration, whereas the NELM theory views migration as a strategy for households to diversify their risk exposure. In this review, we briefly elucidate both theories and why they are inadequate to explain South Asian migration patterns, especially those exacerbated by climate change. Therefore, we create a typology that we call "Multilayered or Integrated Climate-Induced Migration" (MICIM) through which we can more comprehensively explain how climate change exacerbates migration in South Asian countries. We reviewed the existing literature on climate-induced migration in South Asian countries, identified research gaps, and provided suggestions for further research to explore the nexus of climate change and migration in South Asian countries.

The paper is structured as follows. We begin with a background review and introduction to the study (section "Background and introduction"). Section "Theoretical background and existing debates" highlights two major theoretical arguments regarding migration, which are relevant to this study. Section "Methodology", has several subsections that outline overall strategies, from article searching to article selection. Section "Results" then highlights our results. In section "Discussion", we present a discussion based on our findings and identify some gaps that should be addressed in further studies. Finally, we present a conclusion and recommendations in section "Conclusion and recommendations for future studies".

Theoretical background and existing debates

A well-known theoretical argument about migration, neoclassical migration theory, posits that an individual's decision to migrate is determined by the relative costs and advantages (primarily economic) of their present and potential alternative locations. This perspective assumes that prospective migrants are fully informed about the employment opportunities and income levels in the regions where they intend to move. So, their movement decisions are determined by monetary

considerations and personal preferences, and improving their financial situation is their primary motivation (Ahsan et al. 2014). However, the paradigm is criticized for being overly simplistic because it fails to account for market imperfections, presents migration as a purely voluntary choice motivated by the maximization of gains, and understates the significance of policies in the complex relationship between migration, development, and growth (De Haas 2010).

Compared to the dominant neoclassical framework, the new economics of labor migration (NELM) is a radical departure. It does not focus on individual motivations but on the effects on the family. Moving to a new location is seen as a way for them to deal with economic uncertainty and overcome market failures in sectors such as labor, credit, insurance, and other markets (Massey et al. 1993). In this model, remittances are explicitly considered because they represent a direct relationship between the causes and impacts of migration (Taylor 1999). Consistent with the NELM perspective, many studies suggest that migration as a response to environmental stress appears to be a method of household risk diversification (Hunter et al. 2015). Massey et al. (1993) argue that, in the absence of insurance systems, rural households may divert some of their labor supply to metropolitan or foreign labor markets.

In many studies, migratory reactions to environmental strain can diversify household risk, supporting the NELM position (Hunter et al. 2015). Family relocation (McLeman and Smit 2006) is a common response to slow-developing environmental changes, including drought (Findley 1994) and rainfall variability (Warner and Afifi 2014). Natural disasters, on the other hand, can happen suddenly and cause sustained widespread displacement (Sastry and Gregory 2014). El-Hinnawi (1985) defines people forced to flee their homes by natural disasters or environmental degradation as "environmental refugees". The Internal Displacement Monitoring Centre (IDMC 2022) estimates annual weather-related displacements in different regions worldwide; it found that, especially between 2012–2021, storms, floods, wildfires, droughts, extreme temperatures, etc., are the major reasons for displacements. As Findlay (2011) notes, environmental change will most likely magnify and modify pre-existing migration channels during the next 50 years. Table 1 highlights the number of deaths and affected populations, particularly in South Asian countries due to natural (for instance, droughts, wildfires, floods, extreme temperatures, fog, and storm) and technological (for instance, industrial, transport-related, and miscellaneous accidents) causes in the last decade (2013–2023).

In recent years, some scholars have investigated how climate change and other environmental factors influence migration patterns. Some have found that environmental changes, including soil degradation, decreasing agricultural production and firewood, changes in temperature and rainfall patterns, increased droughts, flood or cyclone hazards, and rising sea levels, have direct influences on local communities, perhaps driving them to relocate (Carr 2005; McLeman and Smit 2006; Shrestha and Bhandari 2007; Perch-Nielsen et al. 2008; Massey et al. 2010; Warner 2010; Penning-Rowsell et al. 2013; Martin et al. 2014; Iqbal and Roy 2015; Rahman et al. 2015; Hussain et al. 2016; Bernzen et al. 2019; Jamshed et al. 2020; Sam et al. 2020; Smith and Floro 2020; Gunaratne et al. 2021; Vincent et al. 2021; Sarkar et al. 2022). Furthermore, household water insecurity serves as a driving force that

Table 1 List of deaths and affected populations due to natural and technological causes in South Asian countries during the last decade (2013–2023)

Year	Natural causes (including droughts, wildfires, floods, extreme temperatures, fog, and storms)		Technological causes (including industrial, transport-related, and miscellaneous accidents)	
	Number of deaths	Number of people affected	Number of deaths	Number of people affected
2013	7908	19,794,686	1842	1765
2014	2481	15,232,161	1009	205,742
2015	5060	352,308,519	603	6125
2016	2158	8,142,684	1107	13,623
2017	3238	36,614,479	1095	2301
2018	1938	46,184,466	530	544
2019	3235	36,733,307	571	13,670
2020	3886	30,423,061	294	592
2021	2995	16,776,978	878	108,629
2022	4519	43,864,647	608	5265
2023*	1428	1,583,213	666	16,340

*Latest data as of November 2023
Source EM-DAT (2023)

compels individuals within households to relocate (Stoler et al. 2021). Seto (2011) finds that the presence of dependable water infrastructure is one of the non-economic factors that draw people to Asia's and Africa's mega-delta cities.

In addition to acting as a catalyst for migration, environmental pressures may also be an impediment to relocation for some people (Black et al. 2013) who may not be able to migrate due to related financial and societal constraints because migration requires various resources (Gray and Mueller 2012; Black et al. 2013; Biswas and Mallick 2021). Permanent migration may be negatively impacted by flooding (Chen et al. 2017; Chen and Mueller 2018). For instance, during flooding in Bangladesh, people often cannot afford to relocate (Gray and Mueller 2012). Moreover, disasters can decrease mobility by boosting labor needs at the source (Gray and Mueller 2012).

Although neoclassical theory provides a satisfactory explanation for South Asian migration which is driven by economics and in cases when individuals can make rational choices about where to move, it fails to capture the intricacies of climate change-induced migration. NELM theory is also effective in explaining migration when families want to diversify their income and minimize risk. However, our literature review of South Asian experiences led us to understand that current theories are inadequate, as the migration decision is not only exacerbated by climate change, but various socioeconomic and political dynamics, as well as social inequality, also play important roles in shaping migration decisions. In response, we created the MICIM typology which we believe is fruitful in explaining South Asian climate-induced migration while considering other important non-environmental issues.

Methodology

Article search strategy

To explore the links between climate change and migration in South Asian countries we used the Scopus database to search for articles on this topic. Along with other databases, Scopus is widely used in many previous studies in the environment-related field (Farahani and Maller 2018; Wan et al. 2021; Ahmed et al. 2022). The search process began in February 2023 and continued until mid-May 2023. According to the World Bank (2023) country classification, South Asia consists of eight countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. We used this World Bank country classification and limited our search to these countries. We used keywords such as, "Climate-induced migration in South Asia", "Environmental displacement in South Asia", and "Climate change and migration in South Asia" and restricted our search to English peer-reviewed articles published between 2000 and 2023 (see Fig. 1).

Eligibility criteria

A total of six papers were identified using the search term "Climate-induced migration in South Asia." Additionally, 18 studies were located using the search term "Environmental displacement in South Asia," while 70 were retrieved using the search term "Climate change and migration in South Asia." After downloading all these papers (94 in total) we read their abstracts, found some duplicates, and recognized that not all studies are perfectly related to the aim of this study. We, therefore, decided to construct some eligibility criteria for scrutinizing the articles and selecting the final pieces for review in this study and employed these eligibility criteria to determine the final papers for review in this study:

- Studies that explore climate change and (1) impacts on livelihoods; (2) various coping and adaptation strategies; (3) migration and its underlying causes; and (4) studies that focus on one or more South Asian countries.
- Study design: The study incorporated primary studies using quantitative and/or qualitative methods. We have also included review articles and book chapters. We excluded editorial reports, letters, meeting reports, conference abstracts, opinion-based reports, research ideas, and non-English literature for the final article selection.

Final article selection process for review

After excluding articles that did not meet the eligibility criteria, we had 40 articles directly relevant to our topic of interest; these make up the final sample size for this study. Among the 40 articles, 34 are empirical studies and 6 are review articles and book chapters. Although we are particularly focusing on South Asian countries, some of the selected empirical and non-empirical articles included areas beyond

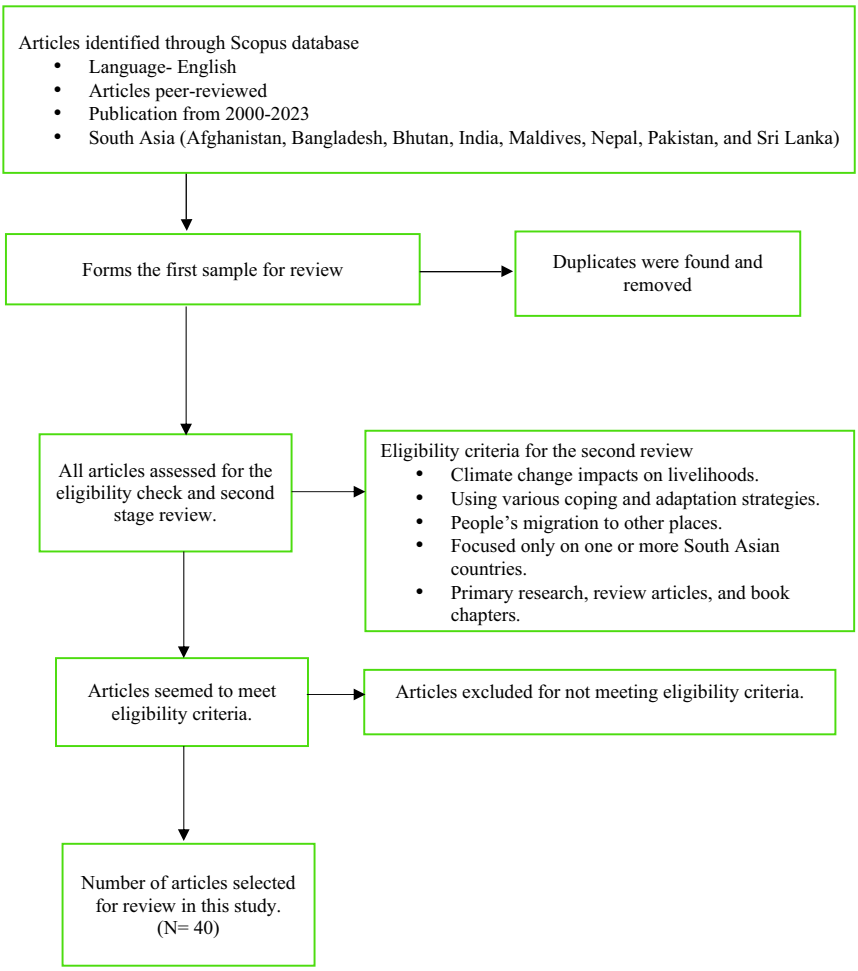

Fig. 1 Flow diagram of the article selection process

South Asia. The review articles, in particular, discuss results from multiple countries outside South Asia. We retained these if they included a focus on any of the South Asian countries' experiences. Figure 2 highlights our reviewed articles by countries. Studies that focus on multiple countries and include other countries (along with South Asian countries) are also represented in this figure. Rather than conducting a meta-analysis, we sought a thorough understanding of the connections between climate change and migration in South Asian countries by reading and synthesizing the articles (empirical and non-empirical) and then created our MICIM typology to explain possible pathways of their nexus. Table 2 presents the major themes based on our review of the 40 articles.

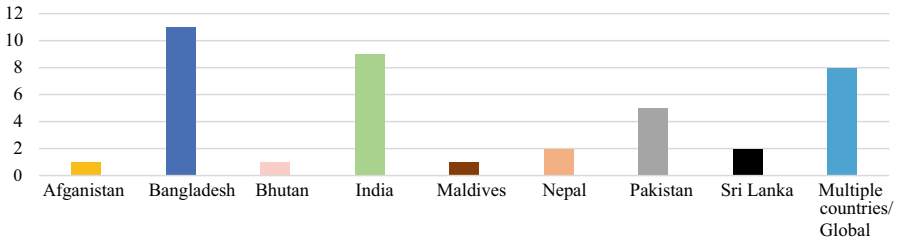

Fig. 2 Reviewed articles by countries

Results

In the literature we reviewed, we learned that it is not sufficient to explain South Asian migration patterns solely by either neoclassical theory, which focuses on better economic opportunities and individual rational choice behind migration, or NELM theory, which views migration as a household risk diversification strategy. We found that migration in South Asian countries is a process influenced not only by climate or environmental issues but also by various socio-economic and political issues that significantly influence migration decisions. This clearly indicates that we need a MICIM typology to explain South Asian migration that is exacerbated by, but not solely due to, climate change.

Our reviewed literature suggests that existing social inequality is also significant in deciding who does and does not migrate in South Asian countries. It is evident that certain demographic groups are more susceptible than others whenever extreme environmental events such as tropical cyclones, floods, and droughts have transpired (McLeman et al. 2016). Prevailing inequalities also play a significant role in shaping human migration as a response to climate change (McLeman and Smit 2006; Bolin 2007). People experiencing inequality are more likely to be displaced by environmental issues yet lack the resources for successful relocation (Black et al. 2011; Cutter 2011). Etzold et al. (2016) found that even well-off families with extensive farmland are vulnerable to changing rainfall patterns. However, having income sources other than agriculture reduces their vulnerability to such fluctuations. Such people are also less likely to experience food insecurity, so can remain in their current location without having to migrate (Etzold et al. 2016).

Individuals from economically disadvantaged groups often face more barriers to migrating whereas individuals who own significant wealth are not compelled to migrate in order to adapt to the adverse impacts of weather patterns. Therefore, it is people who are between these two social poles who tend to adjust to climate hazards and environmental change through permanent, seasonal, and/or temporary migration. The most vulnerable people, often called the "trapped people," are those who find themselves in a situation where they are compelled to remain despite weather fluctuations (Etzold et al. 2016) because the ability to move is linked to various resources including wealth, financial, human and social capitals, location, etc. (Black et al. 2013). The notion of "trapped populations" was also introduced in

Table 2 Major themes of the reviewed articles

Major themes/causes of migration	Empirical studies n = 34
1. Better economic opportunities/ diversifying income sources/better livelihood perspectives	Salik et al. (2023), Vincent et al. (2021), Martin et al. (2014), Penning-Rowsell et al. (2013), Joarder and Miller (2013), Mallick and Vogt (2012), Hazra et al. (2021), Jha et al. (2017), Khetwani et al. (2020)
2. Agricultural production decrease or affected/food or water insecurity/ environmental degradation/decreasing firewood	Iqbal and Roy (2015), Massey et al. (2010), Shrestha and Bhandari (2007), Jamshed et al. (2020), Shahzad et al. (2019), Singh et al. (2020), Warner and Afifi (2014), Alam et al. (2017), Etzold et al. (2014), Biella et al. (2022), Viswanathan and Kumar (2015), Mandal et al. (2023), Chand (2013), Chandrarathna et al. (2020), Gunaratne et al. (2021), Smith and Floro (2020), Hussain et al. (2016)
3. Forced displacement due to climatic events/fear of displacement in the future (floods, cyclones, sea-level rise, extreme heat waves, erosion, droughts, etc.)	Call et al. (2017), Penning-Rowsell et al. (2013), Martin et al. (2014), Rahman et al. (2015), Bernzen et al. (2019), Sam et al. (2020), Sarkar et al. (2022), Debnath and Nayak (2020), Mueller et al. (2014), Salik et al. (2023), Stojanov et al. (2016)
Overarching themes	Non-empirical studies (review papers/ /book chapters) n = 6
1. Climate Change in South Asia	Sivakumar and Stefanski (2011)
2. Various climatic risks cause migration	Farah et al. (2023)
3. Climate Change, Displacement/forced migration, and Conflict	Prívara and Prívarová (2019), Burrows and Kinney (2016)
4. Gaps in the existing literature on climate-induced migration	Ghosh and Orchiston (2022), Obokata et al. (2014)

the UK's Foresight Report of 2011 to refer to those who are very susceptible to environmental changes yet lack the resources to relocate (Foresight 2011). For example, according to Penning-Rowsell et al. (2013), when male members of the family are employed in urban areas, Bangladeshi women may encounter difficulties in relocating from environmentally risky areas. Furthermore, several studies have indicated that individuals may also experience a diminished inclination toward migration (Adams 2016; Farbotko et al. 2018; Zickgraf 2018). For instance, Ahsan et al.'s (2022) study in Bangladesh found that the presence of robust social networks, availability of natural resources, and a sense of community cohesion serve as driving factors for individuals to voluntarily choose not to migrate, even in the face of potential threats.

It is in response to these diverse factors that we propose the MICIM typology (see Fig. 3). We use this typology to provide a more comprehensive understanding of the various migration patterns that have been observed because of the effects of climate change in South Asian countries. The typology incorporates three important routes: migration as a strategy for diversifying means of subsistence; migration as

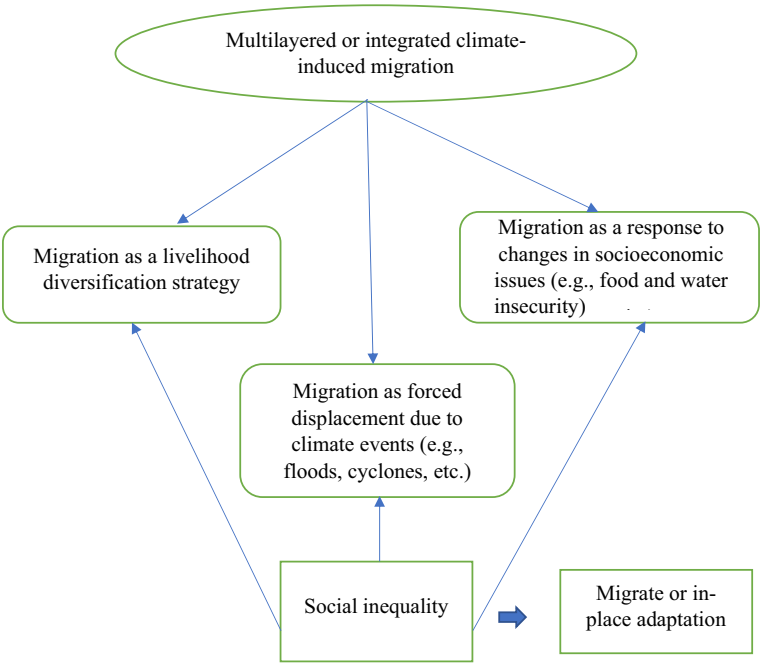

Fig. 3 A typology showing multiple pathways of climate-induced migration and the role of social inequality in migration decisions

a response to socioeconomic issues influenced by climate change; and displacement due to climate events. We discuss these three pathways below:

Temporary migration as a livelihood diversification strategy

Climate change affects people's livelihoods and poor households often experience a greater burden because of their limited ability to adapt. Moreover, they have less access to resources for sustaining their livelihoods (Shahzad et al. 2019). In a case study conducted in Sri Lanka, Chandrarathna et al. (2020) found that respondents in the studied villages, who engaged in paddy farming, depended heavily on timely rainfall. When crops failed due to lack of water, income fell below the level necessary for their family to maintain a standard of living, and they often could not afford to wait for normal rains for another season because of their family's impending financial catastrophe. Accordingly, some of the respondents temporarily relocated to the capital city for work. A similar result was found in Bhutan, where people migrated to other places during winter to earn money to support their families because agricultural production was not sufficient at this time (Chand 2013). Seasonal and cyclical migration is an important part of South Asian internal migration (Srivastava and Pandey 2017). Compared with permanent migrants, seasonal workers are more likely to have lower levels of education, originate from economically depressed and rural areas, and be members of society's most

marginalized and at-risk demographics (Srivastava 2011 2012; Bhagat 2012). The economically disadvantaged segments of India's rural population, for example, are disproportionately likely to resort to seasonal migration as a means of subsistence (Sarkar et al. 2022). These studies also correspond with the study conducted by Khetwani et al. (2020) in Maharashtra, India, where more than half of the participants migrated to other places to maintain their livelihood.

It is not uncommon for families to send a member away to find work so that the rest of the family can benefit financially from the individual's efforts (McLeman and Smit 2006). Because of the unpredictability associated with climate-sensitive jobs, households are increasingly engaging in livelihood diversification as a main strategy for coping with a variety of economic and environmental concerns (Bhatta et al. 2015b), and households' ability to adjust to adversity is greatly increased by remittances (Banerjee et al. 2011). Hazra et al. (2021) found that, in the Mahanadi Delta, India, local people experience various environmental stressors for instance, floods, cyclones, and erosion, which affect their livelihoods; and relocation from the most vulnerable part of the delta to other parts to seek residence and employment, and seasonal migration (almost 56%), are common among woman-headed households. These findings are similar to those in other studies conducted in India. For instance, in the Indian Himalayan Region, Biella et al. (2022) observed that local people are heavily dependent on rainfed agriculture. Local people experience adverse effects, due to the unpredictable rainfall, which makes them unable to depend solely on agriculture for their sustenance and income security. For this reason, many people move to other places to work. In another study conducted in Bihar, India, climate-induced livelihood risk was found to be one of the main reasons for migration. People migrate to other places because they are unable to manage their jobs. The high value and labor requirements of growing rice mean that agricultural households that specialize in rice production are less likely to move during the *Kharif* (monsoon) season. However, some families decide to move during the *Rabi* season (which coincides with spring), when there are fewer available jobs (Jha et al. 2017). Similarly, in Bhutan, since agriculture cannot provide year-round income, many in the region of study leave their villages in search of wage labor elsewhere, especially in the winter season (Chand 2013). According to Tacoli (2009), diversification of income serves as a safety net for farmers.

Migration is common in Bangladesh and has a long history (Siddiqui 2003; Bhuiyan and Siddiqui 2015) as an integral part of survival strategies, especially among those in rural areas, who migrate in search of work opportunities (Vincent et al. 2021). During the *monga* season, when agriculture is not productive, people rely heavily on seasonal or temporary migration to secure their livelihood (Srivastava and Pandey 2017). In a drought-prone region of Bangladesh, Ahmed et al. (2019) found that respondents migrated to other areas to maintain their livelihood. People choose temporary or seasonal migration because there are fewer job openings during the offseason (especially from September to December), and many migrate for two to three months annually. In January, they head back home to harvest. Similar results were found by Martin et al. (2014). As reported by the respondents, rising temperatures and erratic precipitation have made

farming difficult. To diversify their methods of making a living, rural people in areas that are particularly badly hit by changing environmental pressures and shocks are resorting to migration (Martin et al. 2014). Another study was conducted by Call et al. (2017) in Matlab, Bangladesh, where the authors wanted to see how seasonal migration can be predicted by weather factors, including temperature, precipitation, and flooding. Their results show that temporary migration is positively affected by optimal precipitation and high temperatures for up to two years (Call et al. 2017).

Climate change, food and water insecurity, and migration

Climate change impacts, including changes in flooding, drought, and temperature trends, are projected to significantly impact food supply and costs (Easterling et al. 2007). Recurrent droughts and changes in food production and security may lead to migration to places with more reliable food sources and agricultural livelihoods (Kloos and Adugna 1989; Mendelsohn et al. 2007). Using data from the 2014–2015 waves of the Gallup World Poll Survey on 94 low- and middle-income countries, Smith and Floro (2020) found a positive correlation between the severity of food insecurity and the likelihood of migration intention. Hussain et al. (2016) analyzed the effects of extreme weather shocks on agriculture and household food security using data from more than 8,000 households in Pakistan, India, Nepal, and China. Most families mentioned floods, droughts, landslides, etc. as common occurrences, which decreased agricultural production and income. Moreover, because of extreme weather events, the studied households also reported experiencing temporary food insecurity. In Pakistan, Jamshed et al. (2020) found that numerous means of subsistence were harmed by the floods, and the loss of property in agricultural communities was the most devastating effect.

Using district-level data for three inter-census periods (1974–1980, 1981–1990, and 1991–2000) in Bangladesh; Iqbal and Roy (2015) found that climate change affects agricultural production, which in turn affects migration. For instance, they observed that net out-migration rates increase by 1.4–2.4% when real per capita income drops by one standard deviation. In another study among 380 resource-poor riverbank erosion-prone households in Bangladesh, Alam et al. (2017) observed that respondents observed various climatic events such as drought, floods, and cyclones are increasing in their locality which affects jobs and are associated with reduced household food security. A considerable number of small and landless farmers (56%) relied on migration to other places for alternative livelihoods. Similarly, Martin et al. (2014) found that participants in Bangladesh reported increasing temperatures, floods, and unpredictability in rainfall, which affects farming. Moreover, every year, floods last for three to four months, and erosion hurts farming. During this time, there are few job options for the local people, so many households rely on moving to other places (Martin et al. 2014). In Bangladesh, Etzold et al. (2014) found that local people are heavily dependent on agricultural production, and face changes in rainfall patterns along with drought and cyclones. This makes many farmers unable to produce enough food for their families and almost 75% of the studied households faced acute food insecurity. To cope with this

situation, a huge number of participants (79%) considered migration as a viable option. Similarly, Sam et al. (2020) found that to cope with drought conditions, rural households in India follow various coping mechanisms; among them, interstate and intrastate migration are common in the studied area.

Warner and Afifi (2014) found that, despite irrigation, industrialization, and safety nets, seasonal migration is essential for food security in India. At the state and district levels in India, Viswanathan and Kumar (2015) used census data to investigate the correlation between weather, agricultural output, and internal migration. They observed a reduction in agricultural output value due to weather fluctuations, leading to higher emigration rates. Furthermore, a 1% drop in rice (wheat) output is found to be associated with a 2% rise in the rate of out-migration from a state. Analysis at the district level also reveals a correlation between predicted variations in in-migration rates and fluctuations in crop output. A study conducted in South Asian countries by Singh et al. (2020) found that respondents in Nepal are experiencing extreme fluctuations in rainfall patterns in which they observe dry spells and floods occurring with equal frequency. A lack of reliable water sources means that residents of the village struggle to plant paddy at the right time. A major drop in paddy output is the direct effect of these changes in rainfall patterns and for this reason, many people in the community have trouble putting away enough food for the year. Debnath and Nayak (2020) found that villagers in the Bankura district of West Bengal, India, face drought in their area which adversely affects their paddy cultivation. Because droughts occur regularly, people use migration as a major coping mechanism to reduce their risk. More than half of the participants reported that at least one member of their household had migrated. In another study in India, Mandal et al. (2023) found that natural disasters, floods, and hailstorms contribute to food insecurity by influencing long-run household income.

Along with food insecurity, water scarcity is likely to play a significant role in migration, especially in South Asia. Reduced crop yields, partly caused by depleted or polluted water supplies, could lead to a 25% drop in farm-related revenue across South Asia and motivate people to migrate to other places for employment (Ismail 2016). Basu and Shaw (2014) identified several ways in which water scarcity causes migration, including by causing food insecurity, agricultural land damage, increasing salinity levels, diseases, health insecurity, and loss of livelihoods. For instance, migration to cities and job transfers away from agriculture are the main adaptation strategies followed by socially advantaged farmers (dominant castes) in a region of India that is becoming more water-scarce (Fishmana et al. 2013). Water scarcity often leads to drought which contributes to people's relocation. For instance, in 2000 the Baluchistan province, in southwestern Pakistan, was hit with one of the most severe droughts it had experienced in the past few decades. As a result of the drought, crops were severely damaged, and there was a severe lack of animal feed. During this time one million people fled their homes in search of employment, food, and water supply (Basu and Shaw 2014). Likewise, people living in Karnataka, India, who were impacted by water contamination in an industrial region spent more on healthcare overall and were more prone to migration (Madhusudan et al. 2013). In coastal Bangladesh, Rakib et al. (2019) found that rising salinization of the water supply is a contributing factor to the high migration rate.

Climate induced forced migration

Studies claim that mass migration could occur because of catastrophic weather events (Myers 2002; IOM 2010). Disasters like floods and asset destruction can displace many individuals (Laczko and Aghazarm 2009). Climate disasters often cause short-term and intra-country migration. After the initial event, people often move back to their hometowns to rebuild their homes and businesses (Black 2001; McMichael 2014). However, when people in rural areas have few other ways to make a living, they are often forced to relocate permanently (Poncelet et al. 2010; Penning-Rowsell et al. 2013). According to the Internal Displacement Monitoring Centre (IDMC) (2022), of the 38 million internal displacements in 2021, 23.7 million were caused by disasters. In a South Asian study, Singh et al. (2020) noticed that climate change is either explicitly displacing or emphasizing hardship, leading to forced migration. Chandrarathna et al. (2020) conducted their research in Sri Lanka and found that, in the *Aranayake* district, excessive rains led to a major landslide, which caused people to be displaced and relocate to a new settlement. There is also evidence that extreme occurrences in Bangladesh cause people to move elsewhere (Joarder and Miller 2013). For instance, in 2009, Cyclone Aila and the storm surge it created resulted in the rapid displacement of the local residents in Satkhira. This forced people out of their low-lying delta settlements to other locations on a higher level (Martin et al. 2014). The primary factors contributing to migration, as reported by a significant proportion of temporary (80%) and permanent migrants (74%), were drought, riverbank erosion, and flood events (Joarder and Miller 2013). However, Call et al. (2017) observed a contrasting result. They found that migration declines after flooding but soon returns to normal. Another study, conducted by Penning-Rowsell et al. (2013), observed that Gaibandha, a district in Bangladesh was mostly affected by erosion and all the villagers in their study had to move elsewhere a couple of times within the last decade. Similarly, Rahman et al. (2015) noticed that many respondents had their homes destroyed by coastal erosion and floods connected with the tidal waves. A total of almost 46% of the fifty-nine participants in the study area relocated due to the phenomenon of coastal erosion, which resulted in the complete submersion of their residences (Rahman et al. 2015).

Using data from a 21-year (1991–2012) longitudinal survey, Mueller et al. (2014) examined how heat stress influences migration in rural Pakistan. They found extreme heat has a catastrophic impact on agricultural income. Moreover, heat stress also has a negative effect on non-farm income, albeit to a lower extent. Although migratory behavior is used by all people to alleviate heat stress, poor people are more inclined to leave their villages than the wealthy. Reviewing 80 articles in the Pakistan context, Farah et al. (2023) claim that climate change has been linked to both temporary and permanent population displacement due to floods and heat stress. Finally, in Maldives, a study showed that more than half of those surveyed saw rising sea levels as a major national concern in the future and are open to the possibility of migration to other countries (Stojanov et al. 2016).

Discussion

The major aim of this study is to understand how climate change affects migration patterns in South Asian countries. Based on our review of the literature, we created the MICIM typology, which identifies three possible means by which climate change exacerbates migration in the area. First, a frequent means of subsistence in many South Asian countries is short-term migration. Members of lower socio-economic groups often send their family members to cities in search of better job opportunities. When their current living conditions make it impossible to support their families simply from agricultural production, this becomes much more apparent. There are a variety of jobs that the relocated family members can undertake to make money, including making clothes, bricklaying, and driving rickshaws (Ahmed et al. 2019), and are thereby able to send remittances to their families. Moreover, environmental factors often affect people's short-distance migration from their origin. For instance, Massey et al. (2010) found that, in Nepal, environmental degradation, such as decreasing agricultural production, green spaces, and firewood access, increases the likelihood of local relocation. Similarly, Shrestha and Bhandari (2007) found that, in Nepal, a decrease in the availability of firewood increases the likelihood of both internal and external migration. This aligns with the claim of the NELM theory which argues that to deal with economic uncertainty households often see the migration of family members as an option to face various risks (Massey et al. 1993).

The second pathway is that decreased agricultural output due to climate change might cause food insecurity in households, which in turn can trigger migration. Not only in South Asian countries: the UNFCC (2017) listed it as a key cause of forced rural-to-urban migration worldwide. A rise in climate variability and extreme weather events would make food prices more volatile and less stable and lead to huge increases in the cost of food, which is detrimental to the ability of millions of low-income people to access food (FAO 2016). Moreover, water scarcity and insecurity also force people to relocate. In the face of long-term and recurrent drought conditions and changes in food production and food security, individuals may want to relocate to places with more stable food sources and agricultural livelihoods (Kloos and Adugna 1989; Mendelsohn et al. 2007). Until 2019, droughts in Afghanistan forced the relocation of over 287,000 people, primarily from the country's northwestern and western provinces (Prívara and Prívarová 2019). Thus, migration can be a coping mechanism that enhances and diversifies livelihoods, assets, and earnings, thereby reducing food insecurity (Black 2001; Bardsley and Hugo 2010).

The third pathway revealed by the existing studies is climate-induced forced migration. Natural catastrophes in 2020 caused the displacement of 30.7 million people from 149 nations and territories (Ghosh and Orchiston 2022). After Cyclone Aila hit Bangladesh, Mallick and Vogt (2012) found that people from lower socio-economic backgrounds were far more likely to leave their homes. Salik et al. (2023) found that the occurrence of floods in Pakistan resulted in the devastation of people's properties, their businesses, and human lives which gave rise to various

forms of mobility patterns such as displacement, and temporary or permanent migration. Similar results, claiming that people were forced to relocate to other places due to various climatic events were also found in studies conducted by Penning-Rowsell et al. (2013), Rahman et al. (2015), and Martin et al. (2014) in Bangladesh; by Debnath and Nayak (2020) in India; and by Mueller et al. (2014) and Salik et al. (2023) in Pakistan, etc. In the research on the nexus of climate change and migration, these kinds of connections are described as rapid climatic effects on migration patterns (Cattaneo et al. 2019).

Existing empirical studies suggest that climate change often exacerbates migration patterns in South Asian countries and that people often see it as their last option (Debnath and Nayak 2020). Migration decisions are often also influenced by social, economic, and political factors (IOM 2010). People migrate for many reasons (Salik et al. 2023) and non-environmental factors often influence this relocation process (Rahman et al. 2015). In our reviewed studies, we see that in South Asian countries, people's migration decisions often also depend on migrants' social and human capital, especially the support they receive from their relatives (Massey et al. 2010; Bernzen et al. 2019; Salik et al. 2023). Existing social inequality also shapes who migrates and who does not, as resources play a significant role in migration decision-making. For instance, in Bangladesh Bernzen et al. (2019) found that 'resources' play a key role in migration. Bhatta et al. (2015a) conducted a study among 2,660 farm families in India, Nepal, and Bangladesh. They found that rich households usually migrate to other places to increase their resilience while poor families migrate to seek alternative income sources. They also observed that women, children, and the elderly from various financial backgrounds, as well as individuals with moderate income levels, face socio-economic limitations to engage in migration (Bhatta et al. 2015a). Therefore, the environment is found to be merely one of several elements that contribute to long-distance migration (Massey et al. 2010). This finding corresponds with Adamo's (2009) claim that relocation probabilities are often determined by a complex web of environmental, social, economic, and demographic events. In a more specific example, Ghosh and Orchiston (2022) reviewed 161 articles in their systematic literature on climate-induced migration and found that, in addition to climate change, 68 publications cite economic, social, environmental, political, cultural, and psychological causes of migration.

According to our MICIM typology, migration is not solely perceived as the pursuit of economic prospects, as posited by the neoclassical theory of migration. Rather, it is also regarded as a response to the loss of livelihoods resulting from climate change and environmental degradation. The NELM framework places significant emphasis on the influence of households and economic factors in shaping migration choices. In contrast, our proposed framework adopts a more holistic perspective by considering a broader range of factors, including livelihood strategies, a complex interplay between socioeconomic and environmental elements that impact migration decisions, and displacement resulting from climate-related shocks. Moreover, our typology also considers existing social inequality which greatly influences migration decisions in South Asian countries. Here, we present this typology and identify three different means of explaining

South Asian climate-induced migration patterns. Future empirical inquiries should investigate and build upon our typology, especially in the South Asian context. There may be more mechanisms by which climate change intensifies migration in South Asian nations beyond the three pathways that we describe here. Additional research is necessary to not only understand but also explain other possible pathways. It is also important to see whether the MICIM typology can explain climate-induced migration in other places apart from South Asia.

Conclusion and recommendations for future studies

This study aims to understand how climate change affects migration in South Asian countries. Overall, we found that climatic events have a variety of impacts on individuals' primary livelihoods, and temporary migration to other places to earn money seems a viable option for some individual and household livelihoods. Moreover, people in South Asia, especially those who depend on agricultural production, face challenges of food and water insecurity due to climate change, which influences their relocation to relatively more food- and water-secure areas. Furthermore, extreme weather phenomena, such as floods and cyclones, often result in significant detrimental consequences for the inhabitants of the impacted regions. Consequently, many people are forcefully relocated to other places. The occurrence of migratory reactions across populations can be attributed to various factors, including but not limited to environmental alterations and climate change (Black et al. 2011), and migration decisions in South Asia are also influenced by existing social inequality.

We identified several gaps in the literature that we reviewed for this study that need further investigation. First, numerous studies have examined family members' voluntary or forced relocation and the role of remittances that migrants sent to their families. However, more studies are needed to examine how family members who do not migrate adapt in place to the vulnerabilities of climate change. For instance, food and water insecurity may lead one or more family members to migrate elsewhere, but how do the rest of the family members cope with their local food and water insecurity? Remittances may decrease the financial burden for the family and improve the overall financial situation, but do remittances mitigate these insecurities for family members who stay in place? Moreover, further research is required to analyze country-specific characteristics and how, the migration of a family member, specifically long-term and international migration, places an added burden on the mental health of both the migrants and their family members. Climatic pressures have already affected vulnerable people's mental health and relocation may add another layer of stress and anxiety both for migrants and their family members. Migrants often face challenges in managing basic services, for instance, education, housing, food, etc. in the new places to which they migrate. The socioeconomic impacts of migration are very crucial to understand in designing effective policies; further research should focus on exploring these issues.

Second, most of the empirical evidence we reviewed comes from cross-sectional surveys, in-depth interviews, or focus group discussions, and a few from

a combined methods approach. It may be possible to shed more light on the complex dynamics at play in the links between environmental change and migration if longitudinal data are gathered over an extended period of time. Country-specific as well as comparative studies between South Asian countries can also be fruitful in uncovering how countries face environmental issues differently and how these affect migration decisions. Moreover, it would be useful to examine the role of country-level policies in the nexus of climate change and migration.

Third, one of the crucial issues in South Asian countries is to see who decides when and where to migrate. There has been little research on how gender interacts with other aspects of people's lives, such as social class or age, to determine vulnerability to climate change and how people respond to it, especially when making the decision to relocate. We require a more intersectional lens in the South-Asian context to examine migration decisions during environmental change or extreme weather events. Existing literature suggests that social networks, capital and ties play important roles in migration decisions (Salik et al. 2023) but further studies need to explore how these work during extreme weather conditions. More empirical knowledge is needed to understand how social networks can be utilized when facing environmental challenges.

Fourth, we discerned a lack of research focused on thoroughly exploring migration patterns and trends in the climate change-migration nexus in South Asia. Although numerous research studies have been conducted on climate-induced migration within countries, there remains a paucity of comprehensive studies on climate-induced migration between countries.

Fifth, several studies have demonstrated that the effects of climate change are not uniform across all members of society and that existing socioeconomic inequalities mean that not all individuals possess the means necessary to adapt to the changing environment. However, the role of social inequality in migration decisions needs to be emphasized in future studies. Our proposed MICIM typology can be helpful for further studies to examine the roles of existing social inequality in migration decisions, especially due to susceptibility to climate change or extreme weather events.

Finally, we observe that not everyone affected by climate-related events is able to make decisions regarding migration, even if they wish to. For these people, adaptation is a subject that warrants additional exploration of how adaptation strategies among these "trapped populations" through more country-specific studies and, perhaps, more comparative studies. In addition, we need more research on those who may have the means to leave but instead choose to stay and adapt in place. Better policies could potentially help communities adjust to climate change while they are still in their home area by, for instance, allocating funds to alleviate the financial burdens associated with sustaining their livelihoods (Scoones 1999; Nawrotzki and DeWaard 2017); more research is needed to inform better policy recommendations for diverse groups in various contexts in South Asian countries and beyond.

Funding Funding for this work was provided by: NSF EAR-Climate Award #2218664.

Data availability No primary data are associated with this study.

Declarations

Ethical approval The committee' approved the research. This is a literature review-based study. Therefore, it has not been verified or reviewed by any institutional review board.

Confirmation that all research was performed in accordance with relevant guidelines/regulations applicable when human participants are involved (e.g. declaration of Helsinki, or similar) Not applicable.

Informed consent This is a secondary study and there is no data collected from the participants. So, consent was unnecessary.

Conflict of interest There is no conflict of interest.

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