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REVIEW PAPER

A systematic review of climate migration research: gaps in existing literature

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Abstract

Climatic disasters are displacing millions of people every year across the world. Growing academic attention in recent decades has addressed different dimensions of the nexus between climatic events and human migration. Based on a systematic review approach, this study investigates how climate-induced migration studies are framed in the published literature and identifies key gaps in existing studies. 161 journal articles were systematically selected and reviewed (published between 1990 and 2019). Result shows diverse academic discourses on policies, climate vulnerabilities, adaptation, resilience, conflict, security, and environmental issues across a range of disciplines. It identifies Asia as the most studied area followed by Oceania, illustrating that the greatest focus of research to date has been tropical and subtropical climatic regions. Moreover, this study identifies the impact of climate-induced migration on livelihoods, socio-economic conditions, culture, security, and health of climate-induced migrants. Specifically, this review demonstrates that very little is known about the livelihood outcomes of climate migrants in their international destination and their impacts on host communities. The study offers a research agenda to guide academic endeavors toward addressing current gaps in knowledge, including a pressing need for global and national policies to address climate migration as a significant global challenge.

Keywords Climate-induced migration · Climate-induced migrants · Livelihoods · Impacts of climate migration · Systematic review

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Introduction

Population displacement can be driven by climatic hazards such as floods, droughts (hydrologic), and storms (atmospheric), and geophysical hazards such as earthquakes, volcanic eruptions, and tsunami (Smith and Smith 2013). The interactions between natural hazard events, and social, political, and human factors, frequently act to intensify the negative effects of climatic and geophysical hazards, leading to political and social unrest, increased social vulnerability, and human suffering. As a consequence of these adverse effects, people migrate from their native land, causing stress, uncertainty, and loss of lives and properties. However, such migration can also have positive impacts on migrants' lives. For example, migrants may be able to diversify their livelihood and have greater access to education or healthcare.

In 2020, 30.7 million people from 149 countries and territories were displaced due to different natural disasters. Among them, climatic disasters were solely responsible for displacing 30 million people within their own country, with the highest recorded displacement occurring in 2010 when 38.3 million people were displaced (IDMC 2021a; IOM 2021). It is difficult to estimate the actual number of people that moved due to the impacts of climate change (Mcleman 2019), because peoples' migration decisions are triggered by a range of contextual factors (de Haas 2021). Nevertheless, the Internal Displacement Monitoring Centre (IDMC) states that approximately 283.4 million people were displaced internally between the years 2008 and 2020 because of climatic disasters across the globe (Table 1). This number represents almost 89% of the total disaster-induced displacement that occurred during this timeframe (IDMC 2021a).

Table 1 Disaster-induced displacement across the world (2008–2020)

Year	Causes of displacement and displaced population (million)		Total displacement (million)
	Climatic disaster	Geophysical disaster	
2008	22.5	15.8	38.3
2009	15.3	1.48	16.8
2010	38.3	4.05	42.4
2011	13.9	1.14	15.0
2012	29.5	0.678	30.2
2013	20.3	1.83	22.1
2014	17.4	1.74	19.1
2015	14.7	4.46	19.2
2016	23.5	0.715	24.2
2017	18	0.771	18.8
2018	16.1	1.13	17.2
2019	23.9	0.95	24.9
2020	30	0.655	30.7
Total	283.4	35.399	318.8

Source: IDMC (2021b)

People who move from their homes due to climate-driven hazards are described in a range of ways, including climate migrants, environmental migrants, climate refugees, environmental refugees, and so on (Perkiss and Moerman 2018). The process of migration related to climate-driven hazards is variously described as environmental migration, environmental displacement, climate-induced migration or climigration (Bronen 2008).

In this research, we focus on climate-induced migration more specifically induced by slow-onset climatic disasters (sea-level rise, drought, salinity etc.), rapid onset extreme climatic events (storms, floods etc.), or both (precipitation, erosion etc.). This study investigates how climate change-induced migration studies are framed in the existing literature and identifies key gaps in the published literature.

There is a significant ongoing debate about the links between climate change and human migration in the academic literature. Some researchers strongly believe that climate change directly causes people to move, whereas the others argue that climate change is just one of the contextual factors in peoples' migration decisions (Laczko and Aghazarm 2009). Although there are scholarly opinions that call into question climate change as a primary cause of migration (Black 2001; Black et al. 2011; McLeman 2014), there is also evidence that climate change causes severe environmental effects and exacerbates the vulnerabilities of people that force them to leave their place of living (Bronen and Chapin 2013; Laczko and Aghazarm 2009; McLeman 2014).

Moreover, the relationship between the adverse effects of climate change and different types of human mobility (migration, displacement, or planned relocation) has become increasingly recognized in recent years (Kälin and Cantor 2017). It is assumed in general that the number of climate displaced people is likely to increase in future (Mcleman 2019; Wilkinson et al. 2016), and climate change could permanently displace an estimated 150 million to nearly 1 billion people as a critical driver by 2050 (Held 2016; Perkiss and Moerman 2018). As the number of climate migrants increases rapidly in some areas of the world (IDMC 2017), it is now confirmed as a significant global challenge (Apap 2019) and recognized as a considerable threat to human populations (Ionesco et al. 2017).

Climate migration has multifaceted impacts on peoples' livelihoods. Being displaced from their home, people migrate within their own country, described as internal migration, or across borders to other countries known as international migration. Internal movements of climate migrants occur mostly to nearby major cities or large urban centers (Poncelet et al. 2010). Climate migrants who try to move internationally are significantly challenged by two different security problems. Firstly, they cannot live in their own homeland because of worsening climatic impacts and are forced to leave their ancestral land. Secondly, they cannot move to other countries quickly to find a safer place because, according to international law, climate migrants are not refugees and they are not supported by the UN Refugee Convention or any international formal protection policies (Apap 2019; Mcleman 2019). In this situation, they live with significant livelihood uncertainty. The United Nation's Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Risk Reduction (SFDRR) recognize them as a key group that is highly exposed and vulnerable because of their circumstances

(Ionesco et al. 2017). Hence, policy development to address complex climate migration issues has become an emerging priority around the globe (Apap 2019).

In order to address this global challenge, there has been growing academic and policy attention focused on regional (Kampala Convention-2009 by African Union), national (Nansen Initiative—2012 by Norway and Switzerland), and international (Global Compact for Safe, Orderly and Regular Migration- 2018 by United Nations) levels of climate-induced migration in recent years. Myers's (2002) seminal article signposted environmentally driven migration as one of the most significant challenges of the twenty-first century, and later, similar assumptions were made by Christian Aid (Baird et al. 2007), IOM (Brown 2008), and Care International (Warner et al. 2009). Such predictions led to a proliferation of the academic discourse on migration, focused on national and international security, policy frameworks, and human rights (Boncour and Burson 2009). Other studies have focused on vulnerability assessment, risk reduction, adaptation, resettlement, relocation, sustainability, and resilience, considering pre-, during and post-disaster circumstances of climate migration (Bronen 2011; Bronen and Chapin 2013; IDMC 2019; IOM 2021; King et al. 2014).

This research contributes to the discourse by identifying the gaps in the published literature regarding climate migration. A systematic literature review was undertaken to shed light on the current extent of academic literature, including gaps in knowledge to develop a climate migration research agenda. Two notable review papers provided a solid foundation for this endeavor. First, Piguet et al. (2018) developed a comprehensive review of publications on environment-induced migration from a global perspective based on a bibliographic database—CliMig. Their detailed mapping of environmentally induced migration research focused on five categories of climatic hazards (droughts, floods, hurricanes, sea-level rise, and rainfall); however, it did not include salinity and erosion which are also climate-driven and has direct effects on internal and international migration (Chen and Mueller 2018; Mallick and Sultana 2017; Rahman and Gain 2020).

The second key review paper was by Obokata et al. (2014), which provided an evidence-based explanation of the environmental factors leading to migration, and the non-environmental factors that influence the migration behaviors of people. Their scope of analysis was limited to international migration and excluded other types of migration, such as internal climate-induced migration.

Although migration, or more specifically environmental migration, was occurring over many decades of the twentieth century, the IPCC First Assessment report was released in 1990, which presented the first indications of the risks of climate change-induced human movement (IPCC 1990). This milestone report then stimulated the academic discourse, and consequently, a rapid increase in climate migration publication resulted. For this reason, the current study undertook a systematic review of literature across three decades beginning in 1990 and ending in 2019. This study aims to understand how the published literature has framed the climate-induced migration discourse. This paper identifies the key gaps in existing scholarship in this field and proposes a research agenda for future consideration on current and emerging climate migration issues.

In the following section, we outline the systematic review method and identify how journal articles were searched, selected, reviewed, and analyzed. In the next section, we present the results of this study. Results are organized into four subsections that illustrate the reviewed literature in the following ways—spatial and temporal trends, disciplinary foci, triggering forces of migration, and other key issues. Finally, we conclude by identifying research gaps, addressing the limitations of this study, and presenting a research agenda.

Methodology

We have adopted a systematic review methodology for this study because it provides an …*overall picture of the evidence in a topic area which is needed to direct future research efforts* (Petticrew and Robert 2006). Systematic reviews reduce the bias of a traditional narrative review, although it is challenging to eliminate researcher bias while interpreting and synthesizing results (Doyle et al. 2019). It also limits systematic bias by identifying, evaluating, and synthesizing all relevant studies to answer specific questions or sets of questions, and produces a scientific summary of the evidence in any research area (Petticrew and Robert 2006). Moreover, systematic reviews effectively address the research question and identify knowledge gaps and future research priorities (Mallett et al. 2012). We have adopted this approach following the methodology developed by Berrang-Ford et al. (2011) which was tested in the field of environmental and climate change studies, with measurable outcomes. We have conducted the review following these four steps—article search, selection, review, and analysis (Fig. 1).

Article search

We conducted a comprehensive literature search to identify the published academic literature on climate-induced migration to develop a clear understanding of this field of study. We identified sixteen commonly used keywords to search for articles that are predominantly used in the literature. ProQuest central database was selected and used in consultation with a skilled subject librarian to search for the relevant articles for this study. We conducted this literature search in July 2019 using the key thesaurus terms, presented in Table 2. All keywords were then searched individually in the publication's title and abstract. We only considered English language peer-reviewed articles for this study, published between the years 1990 and 2019 (up to June).

Article selection

The main purpose of this process was to ensure the selection of appropriate literatures for further analysis. We approached the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA), a systematic evaluation tool, which was also used by Huq et al. (2021). In stage one of the selection process, 277 articles were counted based on our search criteria. In stage two, we excluded 25 duplicates,

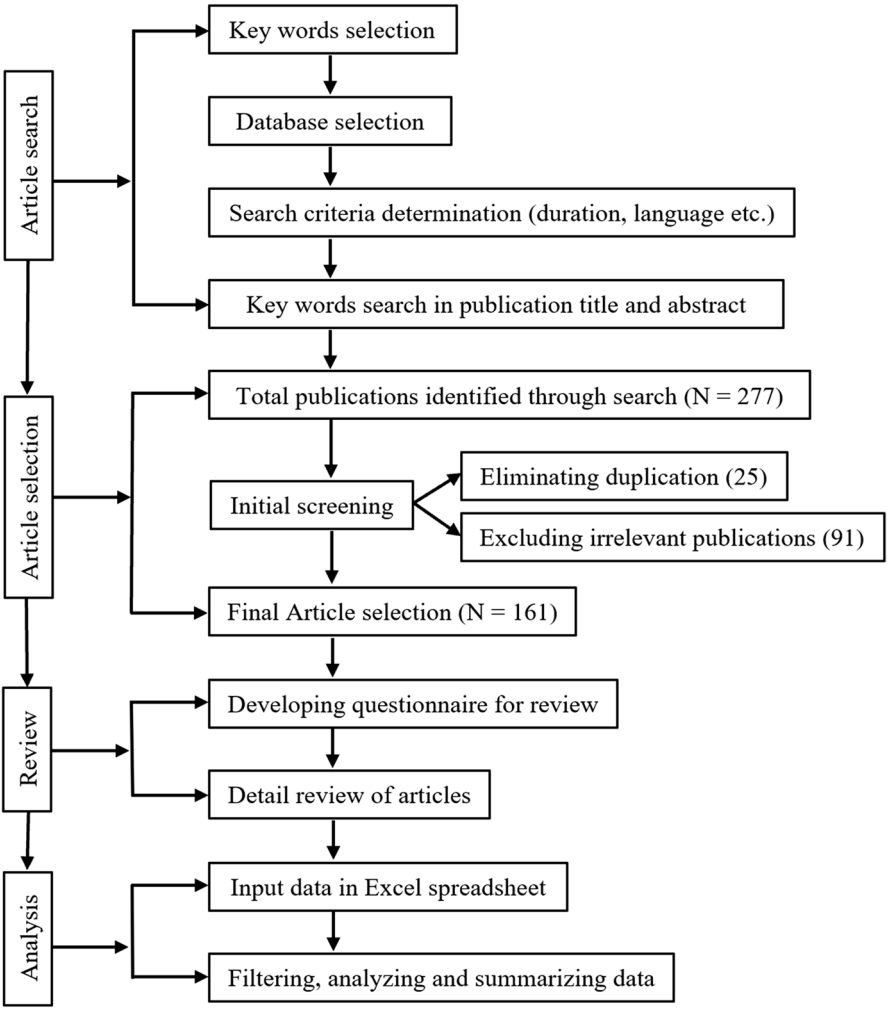

Fig. 1 Systematic review flowchart

and 252 articles remained for further assessment. In the third and final stage of the detailed assessment of each paper, we identified a further 91 publications that were not relevant to our study but appeared in our searched list because search terms were briefly mentioned in their title and/or abstract without being described in further detail. As these articles did not fit with the aim and content of this research, we excluded those 91 and selected a final 161 articles for this study.

Article review

All the selected articles were then considered for detailed review in order to achieve the purpose of the study. A questionnaire (Online Attachment—A) was developed

Table 2 Keywords used for publication search and their representing literature numbers

No	Keywords used for search	Number of publications
1	Climigration	2
2	Climate change migration	37
3	Climate change and migration	38
4	Climate change and displacement	8
5	Climate change displacement	15
6	Climate change-induced migration	7
7	Climate displacement	17
8	Climate-induced displacement	5
9	Climate-induced migration	26
10	Climate migrant	5
11	Climate migration	45
12	Climate refugee	13
13	Disaster-induced migration	1
14	Disaster-induced displacement	9
15	Environmental migration	44
16	Environmental refugee	5
Total publications appeared during the search		277

partially following Berrang-Ford et al. (2011); Obokata et al. (2014) and Piguet et al. (2018) to investigate how climate migration studies are framed in the published literature. Then each article was reviewed in detail in response to the individual parameters of the questionnaire such as general information (*article title, authors name, publication year, journal, discipline, content*), methodological approach (*qualitative, quantitative, mixed*), focused study areas (*country, climatic zones*), source of migrants (*rural, urban*), migration types (*internal, international*), impacts of climate migration (*social, economic, political, health, cultural, environmental, security*), causes of migration (*climatic: flood, sea-level rise, drought* etc., *other: socio-economic, political, cultural*), target communities (*displaced community, receiving community*), and livelihoods (*housing, income, employment,* etc.) of climate migrants described in the publications.

Article analysis

All the data were recorded in Microsoft Office Excel spreadsheets. Relevant data for each parameter were filtered, analyzed, and summarized using the necessary Excel tools. Referencing was compiled through Mendeley Desktop.

Results

Spatial and temporal trend

General information

In this section, the publication date of the reviewed articles was used in order to identify the development of the academic discourse in climate migration studies over the last three decades (1990–2019). Results show the increasing focus of academic attention on this area of research over that timeframe. The study found only four publications between the years 1990 and 1999. During 2000–2009, an additional 16 articles were published, which was followed by an almost 90 percent (141 publications) increase in reviewed articles over the period of 2010–2019 (Table 3).

Reviewed study areas

In 84 reviewed articles, the study reported research focused on a particular location, and in some cases, they considered two or more areas for their research. Therefore, multiple counting for each study has been considered, which represents all the continents except Antarctica. The analysis shows that Asia (38%) is the continent with the greatest number of climate migration studies, followed by Oceania (20%), North America (17%), and Africa (14%). In contrast, Europe and South America have received less attention, with 7% and 5%, respectively. Table 4 presents the distribution of study areas by continent focused on the reviewed papers.

Table 3 Publication year of the climate-induced migration literature

Decade(s)	1990–1999		2000–2009		2010–2019	
	Year	N[a]	Year	N[a]	Year	N[a]
	1990	–	2000	–	2010	7
	1991	–	2001	–	2011	9
	1992	–	2002	1	2012	14
	1993	1	2003	–	2013	8
	1994	–	2004	2	2014	13
	1995	–	2005	–	2015	17
	1996	–	2006	1	2016	10
	1997	2	2007	1	2017	33
	1998	–	2008	8	2018	21
	1999	1	2009	3	2019	9
Total publication	–	4	–	16	–	141
Percentage (%)	–	2	–	10	–	88

[a]Number of publications

Table 4 Distribution of the study areas by continent

Asia			Oceania			North America			Africa			Europe			South America		
Name[a]	N[b]	P[c]	Name[a]	N[b]	P[c]	Name[a]	N[b]	P[c]	Name[a]	N[b]	P[c]	Name[a]	N[b]	P[c]	Name[a]	N[b]	P[c]
Asia	5	8	Australia	2	6	Canada	1	3	Africa	4	17	Europe	7	64	South America	2	25
Bangladesh	21	33	Kiribati	8	24	Caribbean	3	10	Burkina Faso	2	8	Germany	1	9	Colombia	1	13
China	10	16	Marshal Island	1	3	Haiti	1	3	Chad	1	4	Mediter-	2	18	Latin America	3	38
Cambodia	3	5	Micronesia	1	3	Honduras	3	10	Egypt	1	4	ranean (Northern)			Peru	2	25
India	8	13	Nauru	1	3	Mexico	1	3	Ghana	1	4	UK	1	9			
Indonesia	1	2	New Zealand	1	3	Nicaragua	1	3	North Africa	4	17						
Israel	1	2	Pacific	4	12	Panama	1	3	Sahel	3	13						
Jordan	1	2	Papua New Guinea	4	12	USA	18	62	Senegal	1	4						
Maldives	3	5	Solomon Island	1	3				South Sudan	1	4						
Myanmar	1	2	Tuvalu	8	24				Sub-Sahara Africa	4	17						
Nepal	4	6	Vanuatu	2	6				Uganda	1	4						
Philippines	2	3							Zimbabwe	1	4						
Southeast Asia	1	2															
Syria	1	2															
Taiwan	1	2															
Vietnam	1	2															
Total	64	100	Total	33	100	Total	29	100	Total	24	100	Total	11	100	Total	8	100

[a]Name of the study area mentioned by the authors; [b]Number of publications; [c]Percentage of publications

Climatic zones of the reviewed studies

This study identified the climatic zones of the study areas in order to find out which zones are most commonly studied among the reviewed studies. We adopted the climatic zones of the world from Peel et al. (2007), which is the updated version of Koppen's climate classification, and categorizes the world climate into five major zones, i.e., (i) tropical, (ii) arid, (iii) temperate, (iv) cold, and (v) polar. This review shows that 86 publications mentioned their study areas, equating to 54% of the total reviewed papers. Among them, 81% referred to a specific region as their study area. The study areas were then classified into the above-mentioned climatic zones with one reference offered randomly for each country as an example of the range of research that has been conducted.

This study reveals that 49% of this group (among 81%) focused on tropical climatic areas such as Bangladesh (Islam et al. 2014), Cambodia (Jacobson et al. 2019), Kiribati (Bedford et al. 2016), Papua New Guinea (Connell and Lutkehaus 2017), Philippines (Tanyag 2018), Tuvalu (Locke 2009), and Vanuatu (Perumal 2018) among others, and 16% focused on arid climatic zones such as African Sahel (McLeman and Hunter 2010), Israel (Weinthal et al. 2015), Peru (Scheffran 2008), and Senegal (Nawrotzki et al. 2016a, b). In addition to these, 13% of authors focused on temperate regions, i.e., Mexico (Nawrotzki et al. 2016a, b), Nepal (Chapagain and Gentle 2015), Taiwan (Kang 2013), UK (Abel et al. 2013), and the USA (Rice et al. 2015) for their study and 3% focused on cold climatic areas, i.e., Alaska: USA (Marino and Lazrus 2015), Canada (Omeziri and Gore 2014), and northern parts of China (Ye et al. 2012). No studies were found based on polar regions (Fig. 2). Some studies did not specify a region or country of study but instead focused on broader regions such as Africa (White 2012), Asia–Pacific (Mayer 2013), Europe (Werz and Hoffman 2016), Latin America (Wiegel 2017), and Pacific (Hingley 2017).

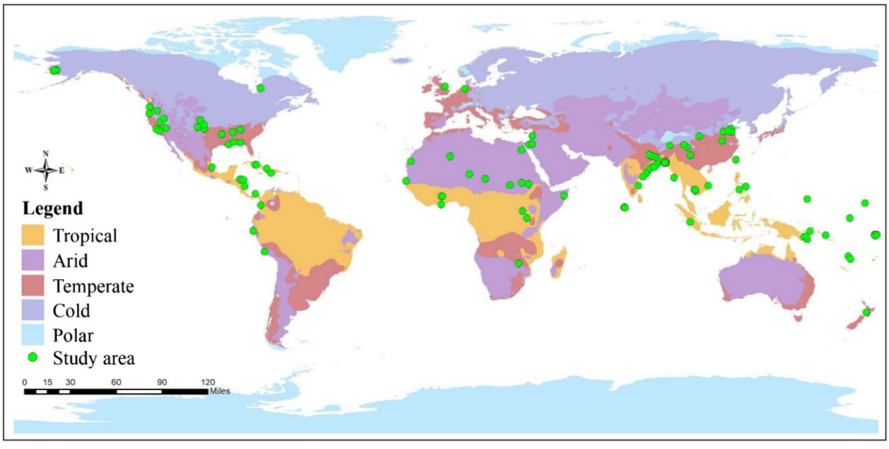

Fig. 2 Climatic zones of the reviewed study areas-adopted from Peel (2007)

Migration types and sources of climate migrants

Migration types here refer to whether migration was internal (within a country or region) or international (across borders), and sources of climate migrants refer to people from rural or urban source regions. Most authors (73%) mentioned nothing regarding migration types, but a quarter (27%) explicitly discussed internal or international migration. Among them, 11% described climate migration within countries and 10% investigated cross-border migration. Some authors (6%) were concerned with both internal and international climate migration. Source regions for climate migrants were not often considered, with only 19 publications mentioning the origin of migrants. Among these, 11 articles stated that migration occurred from rural areas, and two publications discussed migration from urban areas. Also, six articles described climate migration from both rural and urban areas.

Disciplinary foci

Research discipline

This study reveals that climate migration studies are becoming more focal issues in different research disciplines that include more than 40 subject areas. Hence, we developed a typology for the reviewed articles based on the relevant research themes. The typology consists of six research disciplines, each of which includes different subjects, as follows.

(a) *Social sciences:* Social sciences, Sociology, Political Science, International Relations, Comprehensive Works, Population Studies, Anthropology, Social Services and Welfare, History, Philosophy, Ethnic Interests, Civil Rights, Women's Studies
(b) *Geography and environment:* Meteorology, Environmental Studies, Energy, Conservation, Earth Sciences, Geography, Agriculture, Geology, Biology, Archaeology, Pollution
(c) *Business studies and development:* Management, Business and Economics, International Commerce, International Development and Assistance, Economics, Insurance, Investments, Accounting
(d) *Law, policy, and planning:* Law, Military, Civil Defense, Criminology and Security, Environmental policy
(e) *Health and medical science:* Public Health, Psychology, Medical Sciences, Physical Fitness, and Hygiene
(f) *Other:* Literature, Library and Information Sciences, Physics, Technology

Among the reviewed publications, some articles were discussed from the perspective of one particular discipline, while others came from two or more disciplines. Therefore, multiple counting for each discipline was considered during the analysis. The study reveals that Social Science covers the highest percentage of

publications (41%), followed by Geography and Environment (30%), Business Studies and development (10%), Law, policy and planning (9%), and Health and medical science (7%). Only 2% of publications are not covered by any of these disciplines.

Primary research themes

The authors discussed a diverse range of themes in the reviewed articles. Key themes have been classified into eight categories based on their topics and focusing subjects. Some of the publications focused on multiple themes, which were counted separately under each theme. Most of the authors (27%) focused on Politics and policy issues, and almost a fifth (18%) of total articles focused on the themes of population, health, and development issues. Human rights, conflicts, and security issues were discussed in 16% of papers, and climate, vulnerability, adaptation, and resilience topics were the focus of 12% of publications. In 11% of publications, the authors focused on identity and cultural issues, and socio-economic topics comprised a further 9% of the total. Environmental issues were discussed by 4% of reviewed articles and 3% of publications did not fit into any of the above categories and are described as Other.

Methodological approaches

This review identified that researchers applied both qualitative and quantitative methods in climate migration research. A total of 82% of the reviewed articles used qualitative methodologies, and 9% quantitative. In addition to these, 9% of articles used mixed methods in climate migration research. Of those who used qualitative studies, most were review-based (86%), comprising systematic review, empirical evidence-based review, critical synthesis review, critical discourse review, and policy review. Only 14% of qualitative studies used interview methods (7%), case studies (6%), and focus group discussion (1%). Data sources reported in the reviewed literature for the quantitative research included secondary data (73%), historical data (13%), remote sensing data (7%), and survey data (7%).

Triggering forces of migration

Climatic causes of migration

The reviewed publications outlined a range of different causes of climate migration. This study reveals nineteen climate-related causes of migration. We merged these causes into eight categories, defined as (i) climate change (climate change, global warming, temperature, environmental change, climate-induced natural disaster, meteorological events, extreme weather, heatwave), (ii) flood, (iii) sea-level rise (sea-level rise, melting glacier), (iv) drought (drought, desertification), (v) storm (storm, cyclone, hurricane, typhoon), (vi) salinity (salinity, tidal surge), (vii) precipitation-induced landslide, and (viii) erosion (coastal erosion, river erosion). "Climate change" is defined as a separate category because some publications named

climate change as an overarching driver of migration, rather than specifying any particular hazard. In 70 publications, authors mentioned particular climatic events that were solely responsible for human migration, and 53 of these articles predominantly identified climate change as the main driver of migration, followed by sea-level rise (6), drought (4), flood (3), storm (2), and precipitation-induced landslide (2). In the remaining articles, scholars identified two or more climatic events that were collectively responsible for human displacement. Based on these articles, multiple counting for each climatic event was considered and the results show that climate change was the most commonly cited cause in 126 articles, along with other climatic causes. The authors also identified sea-level rise, drought, flood, and storms as the significant drivers of peoples' migration along with other climatic drivers, which were mentioned in 51, 46, 44, and 43 articles, respectively. Precipitation-induced landslide and erosion were recognized in 17 and 12 articles, respectively, as the causes of human displacement, whereas eight articles identified salinity as the main reason.

Influencing causes of migration

Although this review was focused on identifying the climatic causes of human displacement, some other causes emerged during the analysis that also influence migration. In 68 publications, economic, social, environmental, political, cultural, and psychological causes were stated as drivers of migration, in addition to the climatic causes. Among these, economic causes (32%) have been identified as the most common driver, followed by social (25%) and environmental (22%) causes. Some articles described political causes (16%), and the remainder mentioned cultural (3%) and psychological (1%) drivers of migration.

Other key issues

Impacts of climate migration

One of the key findings of this review concerns the impacts of climate migration. In 48 publications, authors described a range of different impacts caused by climate migration, such as social, economic, political, health, cultural, environmental, and security. All the impacts were identified based on the location of climate migrants which are classified into the following three categories: (i) impacts on the place of origin, (ii) impacts on the place of destination, and (iii) impacts on both origin and destination. The review demonstrates that the impacts of climate migration were more frequently identified for the place of origin rather than for the destination. In the place of origin, authors discussed the economic, social, and cultural impacts, compared to political, security, health, and environmental impacts. In contrast, in the destination, scholars were more focused on security and cultural impacts. Overall, security, cultural and economic impacts were the most frequently discussed themes by the authors of reviewed literature in comparison with other impacts (Table 5).

Table 5 Impacts of climate-induced migration

Impact type	Place of origin	Place of destination	Origin and destination	Total	Percentage (%)
Social	5	2	1	8	12
Economic	9	1	1	11	17
Cultural	5	6	3	14	21
Political	2	2	1	5	8
Environmental	4	0	1	5	8
Health	4	2	2	8	12
Security	3	8	4	15	23
Total	32	21	13	66	100
Percentage (%)	49	32	19	100	–

Multiple counting for 48 publications has been considered, and the remaining 113 publications did not discuss any impact

Discussed communities

More than half of the reviewed articles ($N=81$) described climate migrants and/or their receiving communities. In most of the discussions, authors talked about both displaced and host communities together (57%). In more than two-fifths of articles, they considered only displaced communities (42%). In contrast, none of the authors of the reviewed literature discussed host communities in detail in their publications, except Dorent (2011). Only a few authors briefly mentioned host communities during the discussion of climate migration impacts.

Livelihoods of climate migrants

This review demonstrates that the overall livelihood of climate migrants has not been a key focus in any of the reviewed literature. However, a few separate parameters of livelihoods, including housing, income and employment, health, access to resources, and education were mentioned in 23 articles. The analysis shows that the livelihoods of migrants in their place of origin (71%) were more likely to be considered compared to their destination (11%). In some articles (18%), authors addressed the livelihoods of climate migrants considering both their place of origin and destination. In total, all the articles which considered livelihoods had a specific focus on internal migration, and none mentioned the livelihoods of climate migrants in terms of international migration.

Discussion and research gaps

Climate change-induced migration is neither new (Nagra 2017), nor a future hypothetical phenomenon—it is a current reality (Coughlin 2018). This review provides a comprehensive analysis of how this field of study is framed in the existing literature. The academic discourse on human migration due to climate change is suggestive of a long-standing causal connection, which is hard to dissociate (Milán-García et al. 2021; Parrish et al. 2020; Piguet et al. 2011).

The review of spatial and temporal trends of climate-induced migration studies illustrates the growth in the field since the release of 1st IPCC report in 1990. In addition, this review has explored some basic questions that are useful to guide future research in this field of study, for instance, which study areas have received greater or lesser focus? Where are these study areas located in relation to global climatic zones? How are people migrating, i.e., internally, or internationally? What are the spatial sources of climate-induced migrants, i.e., rural, or urban environments?

This review also demonstrates that the expansion of climate migration research increased rapidly after 2000, although the studies in this field began before 2000 (Table 3). It denotes that the global academia and policymakers have emphasized their focus on this topic in recent decades (Milán-García et al. 2021; Piguet et al. 2011). Moreover, this review identifies the Asia–Pacific region as the global 'hotspot' of climate migration research (Table 4). This reflects the IDMC (2019) report that states more than 80% of the total displacement between 2008 and 2018 occurred within this region. Moreover, a significant proportion of global environmental displacement will continue to occur in the Asia–Pacific region (Mayer, 2013). Therefore, this region could be considered as a critical 'living laboratory' for future climate migration research.

Climate migration is mostly occurring internally (IDMC 2021a; Laczko and Aghazarm 2009), and in recent years, it has been widely acknowledged in the policy areas (Fussell et al. 2014; The World Bank 2018). Nevertheless, this study reveals that only a quarter of the reviewed studies for example, Chapagain and Gentle (2015), Islam et al. (2014), and Prasain (2018) have considered the migration types (internal or international) and sources (rural or urban) of climate migrants in their research. Thus, this review identifies the gap and need for contributions to the academic discourse that investigate migration types, the origin of migrants, and their patterns of migration.

The review of the disciplinary foci of climate-induced migration literature reveals that a broader range of disciplines are now focusing on this research topic, which suggests that greater interdisciplinarity is developing in the discourse. IDMC (2021b) data presented in Table 1 show that climate-induced disasters are displacing millions of people every year, but surprisingly none of the reviewed publications appeared under the subject category of disaster management in the database. This reflects the emergent nature of the academic discourse on climate migration and disaster management, which includes recent studies by Ye et al. (2012), Tanyag (2018), and Hamza et al. (2017). In addition, politics and policy

issues regarding climate migration were discussed by scholars; however, no country-specific policies were found during the review that considered both the origin and host communities of climate migrants.

Campbell (2014) argues that there is insufficient empirical evidence within climate migration research. However, this review reveals that research in this area has been undertaken using a range of methodologies, from qualitative (review, case study, interview, focus group discussion etc.) to quantitative (based on survey data, secondary data, historical data, and remote sensing data), which has produced a strong foundation of work to guide future pathways for interdisciplinary climate migration research. A significant proportion of the research to date has been review-based. Also, there is a lack of empirical studies in this research field that consider the application of geographic information system and remote sensing.

It is clear from reviewing the triggering forces of climate-induced migration literature that climatic events are dominantly responsible for climate migration, which is supported by Rahman and Gain (2020), Connell and Lutkehaus (2017), Gemenne (2015), and Kniveton et al. (2012). Despite this, there are some other influencing push and/or pull factors such as socio-economic, political, cultural, etc., which are likely to compound (or be compounded by) climate impacts, to trigger the migration process (Black et al. 2011; de Haas 2011, 2021; Fussell et al. 2014). While there remains ample anecdotal evidence of the relationship between climate change impacts and migration, the specific reasons for people to decide to migrate are interwoven with indirect pressures, such as livelihood disruption, poverty, war, or disaster (Werz and Hoffman 2016). Moreover, why people choose to stay at their places is also essential in the context of creeping environmental and climate-induced migration (Mallick and Schanze 2020).

One of the other key issues reviewed in this study is that the literature to date fails to build an understanding of the impacts of climate migration on both the origin (source regions) and destination of the climate migrants. There are very few studies such as Comstock and Cook (2018), Maurel and Tuccio (2016), Pryce and Chen (2011), Rahaman et al. (2018), Rice et al. (2015), and Schwan and Yu (2017) that investigate different aspects of socio-economic impacts (housing, health, social, economic, etc.) of climate migration in the destination region, and this presents a clear gap in knowledge that requires further study. Also, no current research has been identified during the review that focused on the environmental impacts of climate migration.

In addition, this review identifies that there was less attention paid to the impacts of climate migration on host communities compared to displaced populations in their new locations. Given that migration will continue to increase globally, there is likely to be a growing need to understand the range of potential impacts on host communities. Although some countries and regions are developing policies to manage internal migration, there are no formal protection policies for cross-border climate migration (Nishimura 2015; OHCHR 2018; Olsson 2015; Zaman 2021). Therefore, policy arrangements for managing the needs of climate displaced people in their new communities need to be developed to account for issues related to impacts, livelihoods, community cohesion, and cultural diversity and values. Future research should address the significant gap in understanding the livelihoods of climate migrants in their cross

border or international destination. More specifically, in developed countries where the employment sector is more formalized, there is less room for informal economic practices that are common in developing contexts. More formal employment arrangements make it challenging for migrants to establish new livelihoods, alongside other challenges such as language barriers, and other financial, social, cultural and well-being issues.

Limitations and future research scope

Limitations of this study

There are some limitations to this systematic review; firstly, this review used ProQuest as the sole database for the analysis, and future work could extend the scope to include other major databases. Secondly, this study only considered English language literature, and there are likely to be significant publications in other languages relating to climate migration that were not included in this analysis. Thirdly, looking at pre-1990 or post-2019 literature could add more exciting findings to the search list, which would provide more informative literature. Finally, the outputs of this review are limited to the nature of the search terms, and thus, if other words or texts such as climate-induced relocation or mobility were used, it might extend the range of the review.

Toward a research agenda for climate migration

This review has highlighted several exciting future research opportunities that will build on the strong foundation of work over the past decades in the field of climate migration studies. These include the following research themes; (i) a richer understanding of the full range of impacts (such as social, economic, environmental, and cultural) of climate migration on host communities; (ii) in-depth analysis of the livelihoods of climate-induced migrants in their new destination; (iii) evidence-based research on internal and international climate migration with their sources; (iv) long-term migration policy development at national, regional, or international levels considering both climate migrants and host communities; (v) scope and application of geographic information systems and remote sensing in this area of research, and (vi) developing sustainable livelihood frameworks for climate migrants. The authors believe that academic contributions to these research themes will drive climate migration challenges toward long-term solutions, particularly in those countries that are going to be hosting increasing numbers of climate migrants in future.

Conclusion

This study aimed to understand the past three decades of academic endeavor on climate migration and to identify the gaps in the existing literature in order to inform a research agenda for future research. Climate change, climate-induced migration, and

climate migrants are now considered significant global challenges. Climate migrants are identified as a vulnerable group, and a consideration of issues for this group is essential in addressing the goals of the SDGs and SFDRRR. There is a growing body of knowledge that reflects the global relevance of climate migration as a major current and future challenge (Boncour and Burson 2009). Addressing the issues and challenges of this form of migration will improve the survival and certain resettlement rights of climate migrants (Miller 2017). Therefore, this review contributes a research agenda for future climate migration studies. This study has revealed a critical need to establish a universally agreed definition of 'climate-induced migrants' and 'climate-induced migration,' which remains unclear to date. Lack of clarity only acts to reduce the visibility of issues related to climate-induced migration. In addition, there is a crucial need to improve the evidence base for climate-induced migration by improving current global datasets, to inform local, regional, and global policy development. Policies need to be future-looking in preparation for a rapid and significant increase in climate-related migration across the globe, within and across national borders. For instance, it is important for receiving countries to anticipate an upsurge in migration by developing appropriate policies to support new migrants, particularly regarding visa and immigration arrangements. Addressing current gaps in knowledge will lead to improved pathways to manage this global migration challenge, which is now a critical need if we are to achieve a sustainable future in a climate-challenged world.

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Declarations

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