

Literature Review on Migration, Climate, & Health

Introduction

This article aims to address migration scholarship linked with climate change, using innovations in the field and citing weather events over time (Hunter, Murray, & Riosmena, 2013; Smith & Wesselbaum, 2022; Puente, Perea, & Gitter, 2016). We will also discuss integrated climate change theories of migration and methodological arguments as we identify integrated challenges.

Theoretical Framework

We propose a framework for modeling climate change as a migration driver that focuses on three types of climate change: 1) mean temperature change, 2) extreme temperatures or weather events (e.g., heat waves or heavy rainfall), and 3) episodic events that become more frequent and/or intense (e.g., more intense hurricanes). Our model theorizes how each type of climate change influences human migrations in terms of speed and intensity. It also frames how climate change serves as a context for other migration drivers such as geopolitical conflicts, economic conditions, political (institutional) changes, government instability, and social networks.

Empirical Research

Abubakar, I., Aldridge, R. W., Devakumar, D., Orcutt, M., Burns, R., Barreto, M. L., ... & Zhou, S. (2018). The UCL–Lancet Commission on Migration and Health: The health of a world on the move. *The Lancet*, 392(10164), 2606-2654.

Rationale:

The purpose of this study was to examine the latest evidence on migration and health outcomes. This evidence considers migrant contributions to local economies, offering more to the wealth of host societies than they cost. It addresses increased morbidity (e.g., increased rates of mental illness in victims of trafficking and people fleeing conflict) and in populations left behind in the location of origin.

Research questions:

- 1) What are the key challenges to healthy migration?
- 2) Is failing to be health inclusive more costly to national economies, national security, and global health?

Methods and findings:

The health of people who migrate depends greatly on structural and political factors that decide the impetus for migration, the conditions of their journey, and their destination. Discrimination, gender inequalities, and exclusion from health and social services repeatedly appear as negative health influences for migrants that require cross-sector responses

Adger, W. N., Pulhin, J. M., Barnett, J., Dabelko, G. D., Hovelsrud, G. K., Levy, M., Oswald, Ú. Spring, & Vogel, C. H. (2014). *Human security*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P.R. Mastrandrea, and L. L. White (eds.)]. Cambridge University Press; Cambridge, UK, pp. 755-791.

Rationale:

Mobility is a widely used strategy to support livelihoods in response to social and environmental changes. Migration and mobility are adaptation strategies in all regions of the world that experience climate variability. Specific populations that lack the ability to move also face higher exposure to weather-related extremes, particularly in rural and urban areas in low- and middle-income countries. Expanding opportunities for mobility can reduce vulnerability to climate change and enhance human security.

Research questions:

Human insecurity appears from the interaction of multiple factors, climate change threatens human security through undermining livelihoods, making up culture and identity, increasing migration that people would have avoided and challenges the ability of states to supply conditions necessary for security.

- 1) What are the principal threats to human security from climate change?
- 2) Can lay knowledge of environmental risks help adaptation to climate change?
- 2) How many people could be displaced because of climate change?
- 3) What role does migration play in adaptation to climate change, particularly in vulnerable regions?

Methods and findings:

Climate change and climate variability pose risks to various dimensions of human security, which arise through diverse causal processes, and which will manifest at different scales. There is high agreement in the literature for this conclusion that comes from multiple lines of evidence. There are, however, multiple and competing perspectives on nature and causes of insecurity arising from climate change.

Bellizzi, S., Popescu, C., Napodano, C. M. P., Fiamma, M., & Cegolon, L. (2023). Global health, climate change and migration: The need for recognition of “climate refugees.” *Journal of Global Health*, 13.

Rationale:

Climate change may be the greatest threat to public health in the coming decades, as ensuing environmental variations lead to population shifts.

Research question:

Will formal recognition of climate refugees be developed via structured pathways for regular migration and/or mitigation and adaptation strategies?

Methods and findings:

Future research might focus on investing in early warning systems and preparedness, facilitating transition to environmentally sustainable, green economies and societies (including by building climate-resilient health systems), preventing and addressing

situations of vulnerability (such as promoting inclusion in immunization initiatives and fostering evidence-based decisions and disaggregated data which inform cooperation and scaled-up climate action (Bellizzi, et al., 2021).

Beyea, W., Neumann, B., Cangelosi, E., & Shabaan, A. (2020). Climate and Health Adaptation Planning Guide for Michigan Communities.
<https://www.canr.msu.edu/resources/climate-and-health-adaptation-planning-guide-for-michigan-communities>.

Rationale:

Public health agencies have identified climate change as one of the greatest threats to human health with the most vulnerable people and places feeling the effects more immediately, given racial inequity, environmental injustice, economic disparities, unequal access to health care, and aging infrastructures.

Research question:

What is the context needed to help climate and health adaptation plans to integrate climate and health concepts into existing policy initiatives?

Methods and findings:

Using a case studies approach, a guide was created to help communities in the Great Lakes foster collaboration across disciplines and interest groups to prevent or reduce health impacts of climate change. Core principles include: 1) Centering on health and equity; 2) Engaging diverse partners reflective of the community, especially vulnerable and marginalized populations, along with technical stakeholders and decision makers; 3) Incorporating locally relevant climate and health data in decision making; and 4) Establishing a shared vision for what successful climate adaptation means to the community.

Boas, I., Wiegel, H., Farbotko, C., Warner, J., & Sheller, M. (2022). Climate mobilities: migration, im/mobilities and mobility regimes in a changing climate. *Journal of Ethnic and Migration Studies*, 48(14), 3365-3379.

Rationale:

This article addresses the correlation between the mobile flows of people, ideas, information, climate, and climate risk. The research considers climate mobility regimes and acts of resistance. It considers mass migration and imposed relocation policies, reflecting on politics and cultural dimensions of governance.

Research questions:

How are climate mobilities framed, addressed and governed?

Methods and findings:

- 1) Climate mobilities are complex and affected by multiple conditions
- 2) “Climate mobilities are always relations, across spatial and temporal scales.”
Mobilities and immobilities are physical and spatial and relate across weather, water, plant, animal, energy flows, knowledge, risks and communications.
- 3) The authors give the example of how filmmakers and journalists can introduce ideas into the mainstream media that have implications on climate mobility and can play out across scales, so it’s not just territories that affect climate mobility regimes.
- 4) Mobility justice is addressed, examining the privileged v. mobility of the most vulnerable.

Bowles, D. C., Butler, C. D., & Morisetti, N. (2015). Climate change, conflict and health. *Journal of the Royal Society of Medicine*, 108 (10), 390-395.

Rationale:

The research examines causal pathways between climate change, conflict, and health. The public may be motivated to address climate change when the effects are felt in the disruption of livelihoods and perceived as a public health issue.

Research question:

Public health and conflict are two key results of increased violence. Psychological impacts are felt for years after conflict ceases. Refugees adapting to new cultures and oppressed minorities are also considered. How will unmitigated climate change affect future public health and societal relations?

Methods and findings:

The authors reviewed literature and addressed how unmitigated climate change is predicted to have an impact on material supply chains and affect natural resource allocations of food, water, and land that cultivates food supplies. Climate change is challenging energy and mineral accessibility

Brzoska, M., & Fröhlich, C. (2016). Climate change, migration and violent conflict: Vulnerabilities, pathways and adaptation strategies. *Migration and Development* 5(2), 190-210.

Rationale:

Climate change will result in scarcity which drives migration and violent conflict.

Research question:

What are the environmental, economic and political consequences of climate change that contribute to migration and/or adaptive strategies to environmental change?

Methods and findings:

Empirical research should differentiate between migration and their links to conflict. Some types of migration may be conflict prone and must be tested through comparison of local, national, and international conflict. The gap between climate and migration needs to be closed. Future research might address migration and adaptation. These charts provide helpful evidence:

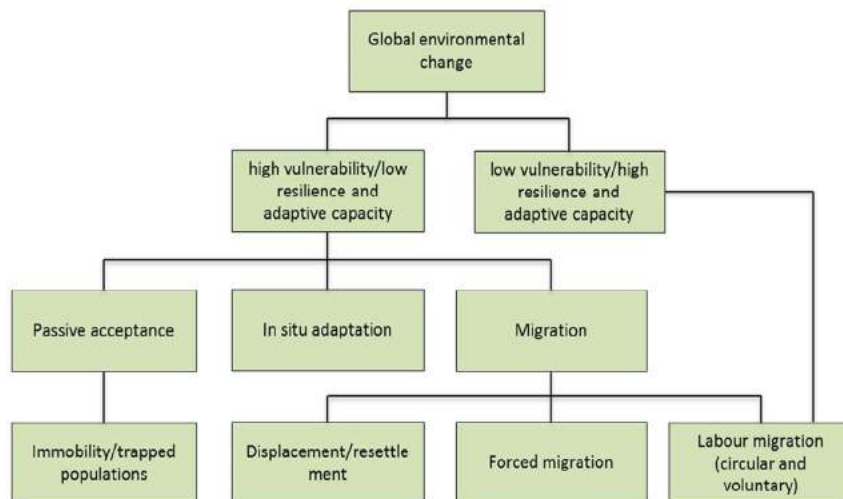


Figure 2. Migration patterns in response to global environmental change.

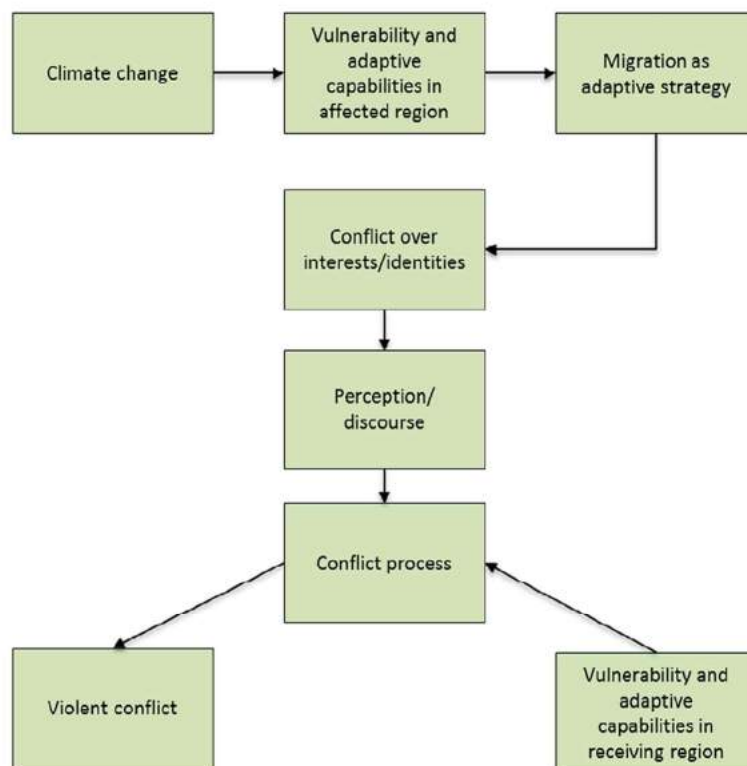


Figure 4. Adaptation and vulnerability in the context of climate migration and conflict.

Table 1. Types of climate migration patterns.

Type	Distance travelled	Permanence	Agency	Economics at destination
Ecological-economic migrants	Direction and distance depending on 'risk capital' and economic opportunities	Temporary (seasonal, life cycle)	Individuals, but often group-decided, predominantly young males Groups	Seeking to be self-supporting, primary aim: remittances
Climate disaster refugees	Short (refugee camp, relatives)	Not permanent, shorter periods of time	Groups	Dependent on external support
Permanent climate refugees	Direction and distance depending on 'risk capital', external support and economic opportunities	Permanent	Groups	Seeking to be self-supporting, tapping external support
Climate-affected migrants	Rerouting of migration patterns	Depends on conditions	Groups	Seeking to be self-supporting

Table 2. Risk factors for violent conflict of different types of climate-related migration.

Type	Conflicts over interests	Identity conflicts	Conflict processes	Likelihood of violent conflict
Eco-economic migrants	Conflict over employment opportunities	Movements into areas with strong and adverse identities	'Otherness' discourses in receiving regions	Generally low except in regions with strong identities and 'otherness' discourses
Climate disaster refugees	Conflict over resources where they are constrained and humanitarian assistance is scarce or not forthcoming	Large-scale movement into areas occupied by hostile identity group	Climate disasters affecting groups involved in violent conflict	Low, because of widespread availability of humanitarian assistance and low capabilities to organize violence
Permanent climate refugees	Conflict over resources, employment opportunities	Movements into areas with strong and adverse identities	Discourses over economic competition and 'otherness' in receiving regions	Depending on intensity of conflicts over interests and identities
Climate-affected migrants	Conflict over resources	Conflict over identities	Dependent on absence, presence of institutions for conflict management	Depending on conflict intensity and absence, presence of institutions for conflict management

Carlson, C. J., Albery, G. F., Merow, C., Trisos, C. H., Zipfel, C. M., Eskew, E. A., Olival, K. J., Ross, N., & Bansal S. (2022). Climate change increases cross-species viral transmission risk. *Nature*, 607(7919), 555-562.

Rationale:

Most viruses (some 10,000 species) circulate among wild animals and do not affect the human population. Climate change and land use may alter viral infection rates.

Research questions:

Will increased viral surveillance and discovery effects of biodiversity, especially in tropical regions improve risks to public health?

Methods and findings:

Simulated hotspots of future viral sharing will have an effect on disease emergence. Bats account for the majority of new viral sharing with humans given their unique dispersal ability. Also consider defaunation at low level elevations might interact with disease

prevalence. Sea mammals, birds and amphibians should also be modeled. This study is a template for how surveillance could target future viral emergence in wildlife.

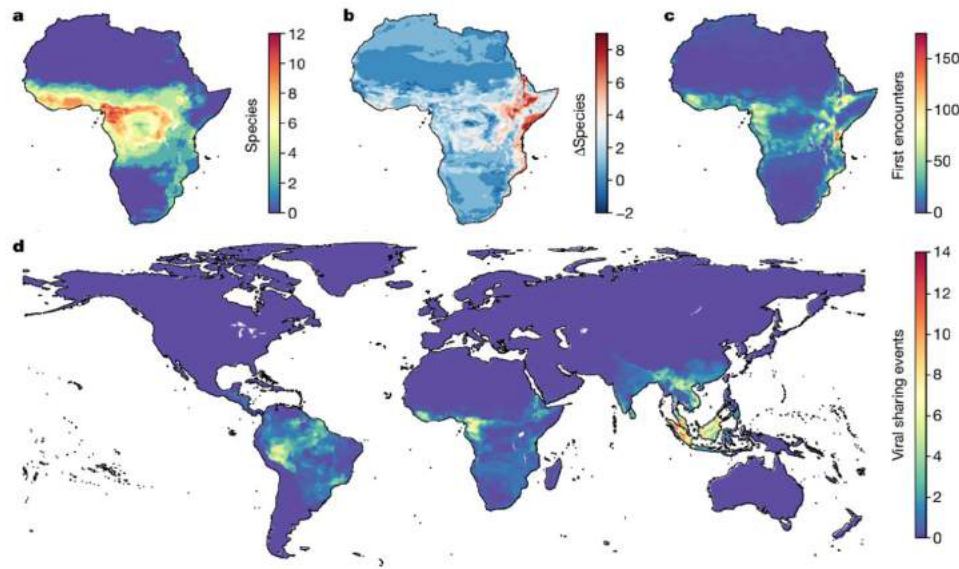


Fig. 3 | Range expansions will expose naive hosts to zoonotic reservoirs. a, The predicted distribution of known African hosts of ZEBOV. b, The change in richness of these hosts as a result of range shifts (SSP1-RCP2.6). c, Projected

first encounters with non-Ebola hosts. d, Bat-primate first encounters are projected to occur globally, producing new sharing events. The results were averaged across nine GCMs.

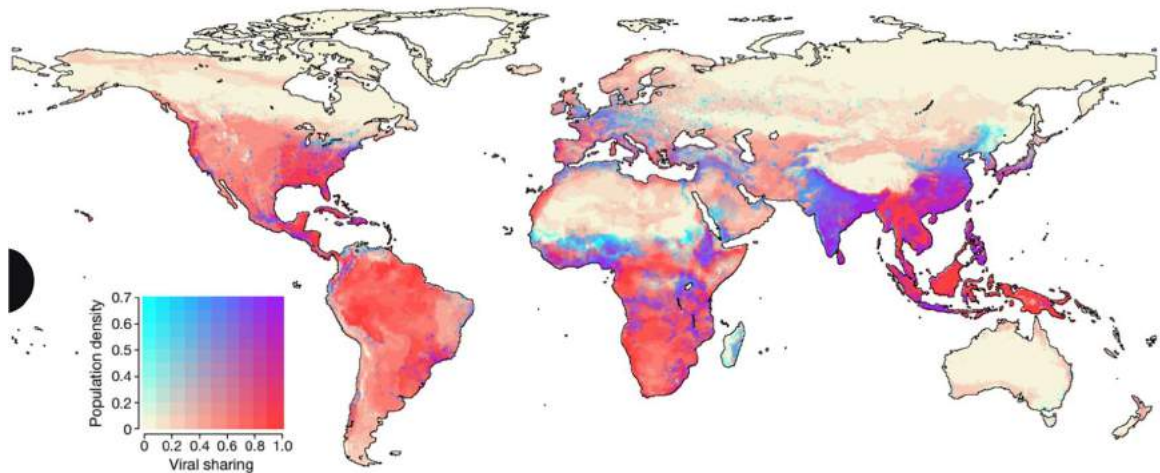


Fig. 4 | Novel viral sharing events coincide with human population centres. In 2070 (SSP1-RCP2.6; climate only), human population centres in equatorial Africa, south China, India and southeast Asia will overlap with projected

hotspots of cross-species viral transmission in wildlife. Both variables were linearly rescaled to 0 to 1. The results were averaged across nine GCMs.

Cooper, L., & MacFarlane, D. (2023). Climate-Smart Forestry: Promise and risks for forests, society, and climate. *PLOS Climate* 2(6): e0000212.
<https://doi.org/10.1371/journal.pclm.0000212>

Rationale:

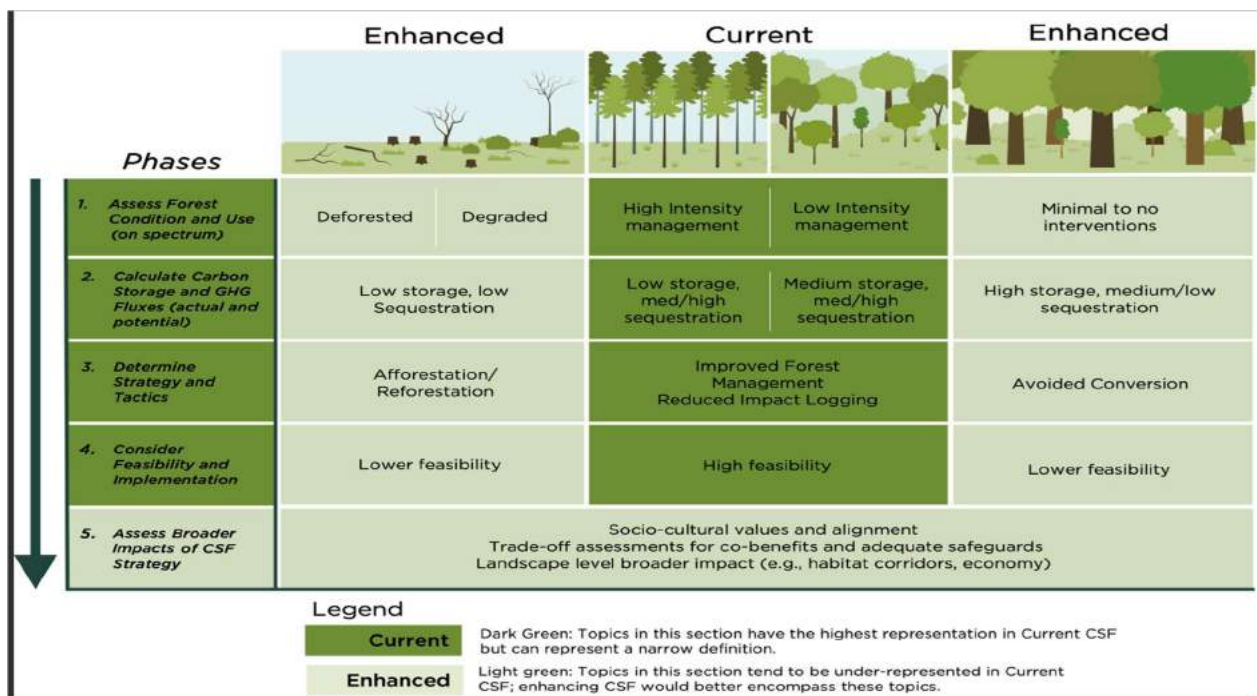
Climate Smart Forestry is defined and framed. Climate Smart Forestry is explored as a potential risk and examines science practice gaps in being addressed as a national policy.

Research questions:

Is Climate Smart Forestry adequately defined and do interpretations present risks to environment, society and climate?

Methods and findings:

Scaled application of Climate Smart Forestry could result in undesirable outcomes for biodiversity, climate and society. Analysis in the literature shows a science to practice gap. An enhanced framing would reduce risks by drawing on broader science of applying knowledge of carbon, climate, forests, habitats, economics, participation in justice and diverse values of nature.



de Sherbinin, A., Grace, K., McDermid, S., van der Geest, K., Puma, M. J. & Bell, A. (2022). Migration theory in climate mobility research. *Frontiers in Climate*, 4, 882343.

Rationale:

The purpose of this article is to explore migration theory and how it is used to frame climate related migration with suggestions for using theory in better understanding climate mobility.

Research questions:

Examining a review of 75 empirical studies, the authors of this paper would like to better understand migration theory and its intersections with climate change.

“Who migrates; why do they migrate, what types of mobility do they employ, what sustains migration streams; and why do they choose certain destinations over others?”

Methods and findings:

The literature demonstrates that few alternative theories were considered or tested. Theories focusing on individual level decision making were more likely to be utilized over structural theories that stress macroeconomic and demographic factors as underlying causes for migration. There is little mention of forced migration or immobility in the literature discussing climate mobility.

Theory	Primary theory	Secondary theory	Total	Primary theory %	Secondary theory %	Percent total
NELM	16	2	18	21.3	5.1	24.0
Other theories	14	4	18	18.7	10.3	24.0
Env'tal mig frameworks	10	6	16	13.3	15.4	21.3
Neoclassical	13	3	16	17.3	7.7	21.3
Livelihoods framework	6	7	13	8.0	17.9	17.3
Push-pull	6	6	12	8.0	15.4	16.0
No theory	6	0	6	8.0	0.0	8.0
Aspirations and capab.	1	4	5	1.3	10.3	6.7
Historical-structural	0	4	4	0.0	10.3	5.3
Theories sustained mig.	2	2	4	2.7	5.1	5.3
Forced migration	0	1	1	0.0	2.6	1.3
Mobility transition	1	0	1	1.3	0.0	1.3
Grand total	75	39	114			

Ebi, K. L., Vanos, J., Baldwin, J. W., Bell, J. E., Hondula, D. M., Errett, N. A., Hayes, K., Reid, C. E., Saha, S., Spector, J., & Berry, P. (2021). Extreme weather and climate change:

Population health and health system implications. *Annual Review of Public Health*, 42(1), 293-315.

Rationale:

Extreme weather is an expression of climate variability. Reducing health risk is required to provide a proactive response to assist vulnerable populations and build awareness among the public and improve the resilience of health systems.

Research question:

Conducting vulnerability and adaptation assessments while developing systematic health management plans can reduce risk and mitigate disaster, at the same time, promote a more resilient infrastructure.

What are the dynamics that help us understand climate extremes and quantify risks to populations and communities?

Methods and findings:

Cross-disciplinary efforts examine population health, economics, and climate to evaluate adverse risks of climate change. There is a mismatch between funding available to health institutions and organizations researching climate adaptation to investigate health risk management. It is important to change the mindset through education and capacity building to better understand the critical links, especially needed to protect the most vulnerable individuals and Healthcare infrastructure well addressing inequities in disaster risk.

Frumkin, H., Hess, J., Lubet, G., Malilay, J., & McGeehin, M. (2008). Climate change: The public health response. *American Journal of Public Health*, 98(3), 435-445.

Rationale:

There are well known effective public health responses for global climate challenges, however, the impact, scope, timeline, and complexity are unprecedented. The researchers are proposing a coordinated effort to advance solutions through enhanced cooperation between clinical and public health officials, government agencies, academia, private sector, and nongovernmental organizations.

Research question:

What are new insights and innovations to health problems caused by climate change?

Methods and findings:

“Primary prevention corresponds to *mitigation*—efforts to slow, stabilize, or reverse climate change by reducing greenhouse gas emissions. Secondary and tertiary prevention corresponds to *adaptation*—efforts to anticipate and prepare for the effects of climate change, and thereby to reduce the associated health burden.” Medication will be focused on energy, infrastructure, transportation, architecture. adaptation efforts will be focused more on conventional medical and public health practices.

The 10 Essential Services of Public Health, With Climate Change Examples

Service	Climate Change Example
1. Monitor health status to identify and solve community health problems.	Tracking of diseases and trends related to climate change
2. Diagnose and investigate health problems and health hazards in the community.	Investigation of infectious water-, food-, and vector-borne disease outbreaks
3. Inform, educate, and empower people about health issues.	Informing the public and policymakers about health impacts of climate change
4. Mobilize community partnerships and action to identify and solve health problems.	Public health partnerships with industry, other professional groups, faith community, and others, to craft and implement solutions

5. Develop policies and plans that support individual and community health efforts.	Municipal heat-wave preparedness plans
6. Enforce laws and regulations that protect health and ensure safety.	(Little role for public health)
7. Link people to needed personal health services and ensure the provision of health care when otherwise unavailable.	Health care service provision following disasters
8. Ensure competent public and personal health care workforce.	Training of health care providers on health aspects of climate change
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.	Program assessment of preparedness efforts such as heat-wave plans
10. Research for new insights and innovative solutions to health problems.	Research on health effects of climate change, including innovative techniques such as modeling, and research on optimal adaptation strategies

Source. Public Health Functions Steering Committee.

Ghimire, R., Ferreira, S. F. & Dorfman, J. H. (2015). Flood-induced displacement and civil conflict. *World Development*, 66, 614-628.

Rationale:

Climate change can lead to mass displacement. The researchers examine displacement caused by flooding, affecting civil displacement and increased risk of social tensions in 126 countries during 1985 - 2009.

Research question:

Climate change is a global security threat and destabilizes fragile countries. Environmental factors are predicted to be a driver of migration decisions during the 21st century. What role have natural disasters played in altering migration patterns?

Methods and findings:

Results suggest that climate events of flooding did not ignite new conflicts but fueled existing conflicts advancing five years following the flood. The effects were marked greater in developing countries.

Table 1. Descriptive statistics (unit of observation is country-year, id = 126 countries, n = 2697 observations, years = 1985–2009)

Variables	Mean	Std. Dev.	Min	Max
Conflict onset	0.03	0.17	0	1
Conflict incidence	0.17	0.38	0	1
Flood-induced displacement	113,677	946,660	0	2.37e + 07
Infant mortality rate	41.19	36.98	2.1	167.2
GDP/capita	6,693	9,529	58	41,904
GDP growth	3.63	5.51	-51.03	106.27
Youth population (%)	18.05	3.00	0.05	26.10
Population density	148.34	537.51	1.31	7,125.14
Oil wealth (=1)	0.61	0.49	0	1
Ethnic tensions	3.97	1.41	0	6
Democracy (=1)	0.54	0.49	0	1
Instability (=1)	0.11	0.31	0	1
Anocracies (=1)	0.25	0.43	0	1
Country area, km ²	992,996	2,192,296	670	1.64e + 07
Terrain ruggedness	0.63	0.41	0.01	2.20
Conflict in neighboring countries (=1)	0.47	0.50	0	1
Brevity of peace	0.23	0.39	0	1
Rainfall variability (mm)	60.44	48.71	0.86	391.15

Haines, A., & Ebi, K. (2019). The imperative for climate action to protect health. *New England Journal of Medicine*, 380(3), 263-273.

Rationale:

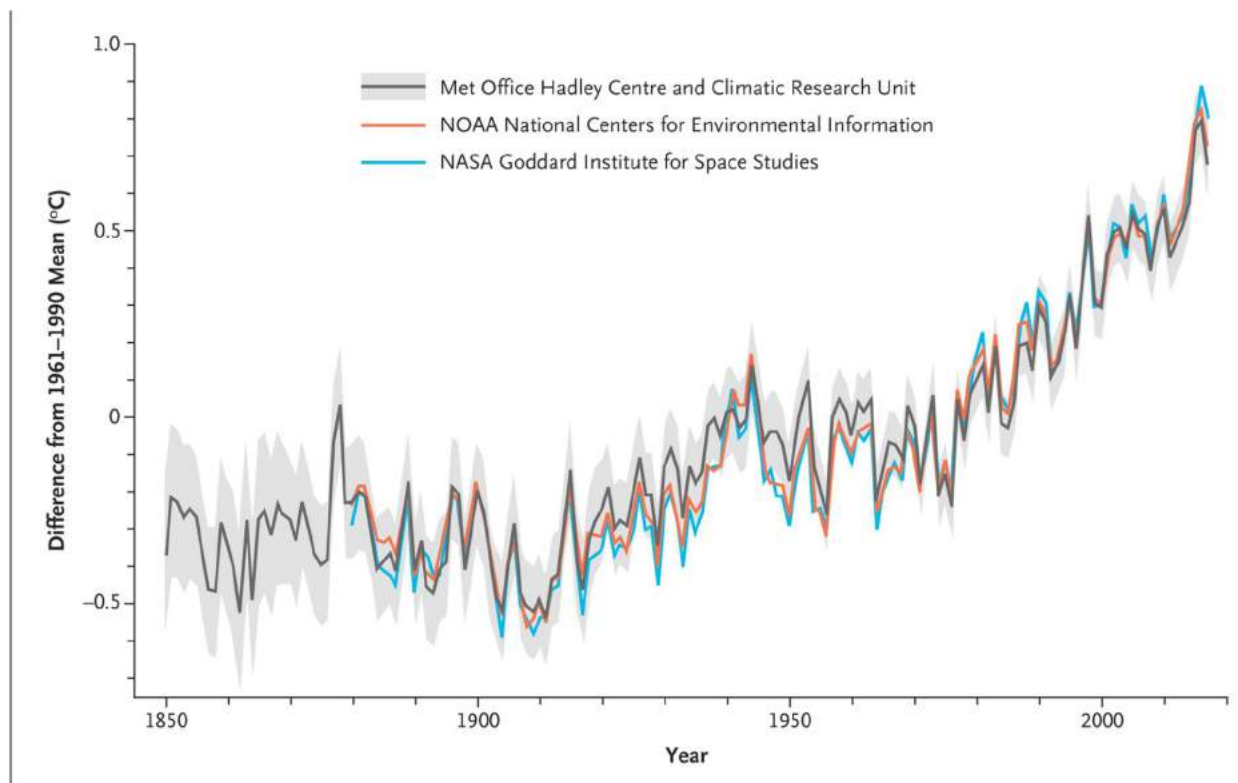
Climate change is having adverse effects on human health and health systems. Without mitigation, increases in morbidity and mortality are expected, along with health outcomes related to poor air quality, undernutrition from reduced food quality and food insecurity, with increases in poverty and inequity, having the greatest impact on the most vulnerable.

Research question:

What are the health risks associated with a changing climate?

Methods and findings:

A statistical method of detection and attribution shows a trend in climate or health variability. Studies using this method demonstrate greenhouse gas emissions changing the Earth in ways that affect human health, e.g., the surface temperature of the ocean, extreme weather events, etc. This is having an impact on Vector borne diseases and related And affects mediated through social economic systems for example health consequences of poverty.



Harper, S. L., Cunsolo, A., Babujee, A., Coggins, S., Aguilar, M.D., & Wright, C. J. (2021). Climate change and health in North America: Literature review protocol. *Systematic Reviews*, 10(3) <http://doi.org/10.1186/s13643-020-01543-y>

Rationale:

Research evidence is needed to demonstrate climate change impacts on human health for improvements in policy and planning.

Research questions:

Climate health literature is needed to support and encourage improved policy and planning in the health community.

Example questions		
1.	What types of published literature exist on climate change and health in North America?	<ul style="list-style-type: none"> • Primary research articles • Review articles using systematic methods
2.	What are the North American publication trends over time?	<ul style="list-style-type: none"> • Year of article publication
3.	What is the geographical distribution of research and data in North America?	<ul style="list-style-type: none"> • Canada • United States of America (USA) • Mexico • Multinational, including North America
4.	What types of climate-health data are being assessed in the literature? What is the nature of climate-health literature and state-of-knowledge for different health outcomes?	<ul style="list-style-type: none"> • Weather data (e.g. temperature, UV, precipitation) • Climatic hazard data (e.g. hurricanes, wildfires, heat events, air quality) • Health data (e.g. heat morbidity and/or mortality, respiratory illness, vectorborne diseases) • Social characteristics as they relate to impacts on climate-sensitive health outcomes (e.g. gender, income, education, ethnicity)
5.	What aspects of climate change are being focused on in North America?	<ul style="list-style-type: none"> • Climate change impacts • Climate change adaptation • Climate change mitigation
6.	What research methodologies are being used?	<ul style="list-style-type: none"> • Qualitative research/quantitative research/mixed qualitative and quantitative research • Inclusion of future climate projections
7.	What are key climate-health risks in North America?	<ul style="list-style-type: none"> • Intersection of climatic variables, health outcomes, and social characteristics
8.	What climate-health adaptation strategies are effective in North America, for whom, under what conditions, and why?	<ul style="list-style-type: none"> • Climate change adaptation

Methods and findings:

A literature review was conducted examining climate and health in North America. The goal was to create a database of articles that examine the climate Health Nexus in North America.

He, L., Kreske, E., Nawyn, S. J., Pearson, A. L., Axelrod, M., Pokhrel, Y., Gasteyer, S., Lawrie, S. & Kendall, A. (2023). Interventions addressing conflict in communities hosting climate-driven migrants: Literature review. *Environment and Security*, 0(0). <https://doi.org/10.1177/27538796231207919>

Rationale:

There is currently limited assessment examining how climate change or resource scarcity caused by climate may influence adaptive capacity in receiving migrant communities, and how decision-making, interventions, and power relations in communities where migrants land may fuel or reduce conflict and migration. A literature

review ensues assessing 33 articles that examine conflict in communities hosting climate migrants.

Research questions:

- 1) Does climate change cause environmental changes that lead to resource scarcity?
- 2) Does scarcity-and resulting livelihood or food/water/energy insecurity—related to natural hazard events and long-term changes in climate conditions indeed drive human migration?
- 3) When people migrate due to climate hazards or trends, do they actually come into conflict with host communities due to increased demand for local resources and therefore exacerbate local/regional resource scarcity?

Methods and findings:

This literature review examines existing interventions to reduce resource conflict in communities hosting climate refugees. The authors identified gaps to be addressed in future research and shared the following tables report findings:

Table 1. Existing intervention measures discussed in our sampled literature set.

Intervention type	Specific example(s)	Referenced literature
International humanitarian aid programs	Food, water, shelter, and emergency health care services provided by UNHCR, UNICEF, OHCHR	Warner et al. (2010) , Martin (2012) , El Hassan (2014) , Lindvall et al. (2020)
Migration-related legislation and treaties (international and domestic)	1951 refugee convention and its 1967 protocol, international human rights law, and international refugee law	Kirsch-Wood et al. (2008) , Albuja and Adarve (2011) , Pacheco (2018)
Regional-level climate adaptation and mitigation measures	Capacity building projects provided by the Caribbean community climate change center	Pacheco (2018)
National-level land laws or land management rules	The Mongolian land law which has effects on livestock privatization on pastoral land use and land tenure	Janes (2010) , Owuor et al. (2011)
National- and local-level relocation incentives	Land and parcel allocation, provision of food, water and sanitation, provision of work-for-assistance programs	Warner et al. (2010) , Anurag Danda et al. (2019) , Islam et al. (2021)
Local-level sustainable land- and water management practices	Cropping management, water management, cross-slope barriers, grazing land management, and forest management	Ayeb-Karlsson et al. (2016) , Schwilch et al. (2014) , Owuor et al. (2011) , Mulligan et al. (2017)
Local-level conflict resolution methods	Interventions by local elders, water-user associations, or formal courts	Iqbal et al. (2018) , Odalonu (2020)
Local-level environmental communication models	Training of local educators that attempt to amplify resilience and adaptation skills to the locals of the hosting areas	Kounani and Skanavis (2019)
Local-level co-development projects	Bottom-up initiatives in water, food, and energy sector that are co-financed by migrants' home- and receiving communities	Scheffran et al. (2012)

Table 2. Main actors and geographical hotspots in existing intervention measures.

Intervention type	Main actors involved in the intervention	Geographic locations of the discussed communities
International-level interventions	International humanitarian agencies, Intergovernmental organizations, and NGOs (e.g., UNHCR, UNICEF, OHCHR), local health facilities	Middle East (e.g., Jordan and Syria); African countries (e.g., Somalia, Kenya, and Ethiopia)
Regional-level interventions	Caribbean Community Climate Change Center, Intergovernmental organizations (e.g., UNDP, GEF, the World Bank)	Central America (e.g., Belize)
National-level interventions	National governments, local governments, local support groups, NGOs	Egypt, Vietnam, Mozambique
Local-level interventions	Local governments, civil society organizations (e.g., water-user associations), the court, researchers, NGOs, emigrant organizations, private companies	Asian countries (e.g., Afghanistan), Mediterranean countries (e.g., Syria, Greece), African countries (e.g., Mali, Mauritania, Senegal, Kenya)

- 1) There is a lack of research related to resolving conflicts related to climate change migration
- 2) There is a gap in research examining adaptive capacity of migrants related to multiple threat factors.
- 3) There is limited research on how institutional actors can facilitate access to resources in new communities. Power imbalances exist.

Henningsen, G. (2023). Big data for the prediction of forced displacement. *International Migration Review*, 0(0). <https://doi.org/10.1177/0197918323119>

Rationale:

The researchers outline the potential for data analytics Within predictive work of humanitarian responses in refugee crises. This paper considers opportunities and challenges of aligning data with UNHCR goals of accuracy, scalability, and sampling bias.

Research questions:

- 1) What are the factors that lead to an event that can trigger forced displacement?
- 2) What are the characteristics of an event that have the potency to create forced displacement flows?

3) What are the factors that impede the magnitude, demographic, and direction of force displacement?

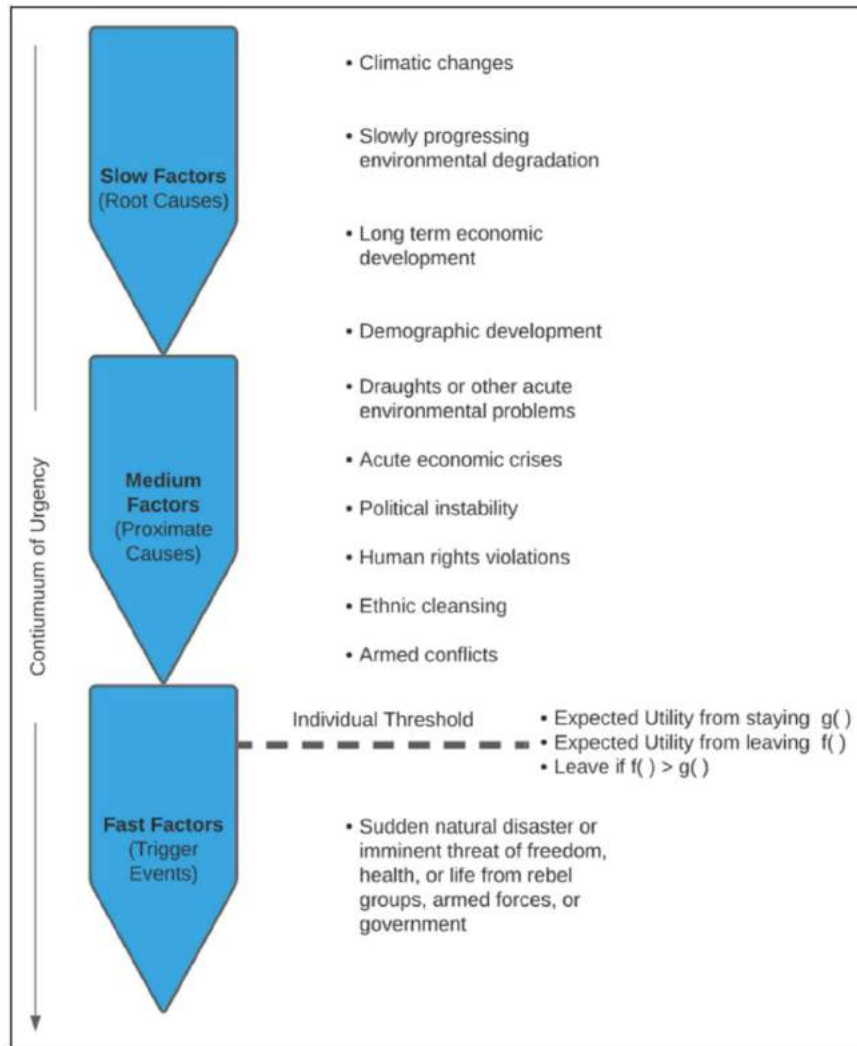


Figure 1. Event chain from root causes to trigger events.

Methods and findings:

Proper knowledge of data biases, problems with data accuracy, biases in the data, low scalability, signal to noise ratios, and combining non-traditional data sources with traditional sources with different units of measurement are all challenges that impede Big Data usage.

100 million+ people were forcibly displaced in 2022; the author equates this with “every 80th person is now forcibly displaced...!”

See also, related data on Climate, Displacement and Health big data analytics from the [World Bank](#)

Hunter, L. M., Murray, S. & Riosmena, F. (2013). Rainfall patterns and US migration from rural Mexico. *International Migration Review* 47(4), 874-909. doi: 10.1111/imre.12051.

Rationale:

Using US emmigration models from rural communities, the authors examine rural Mexican migration to the United States based on annual rainfall patterns. Weather variability associated with climate change may increase the frequency and severity of natural disasters, thus having a profound impact on migration.

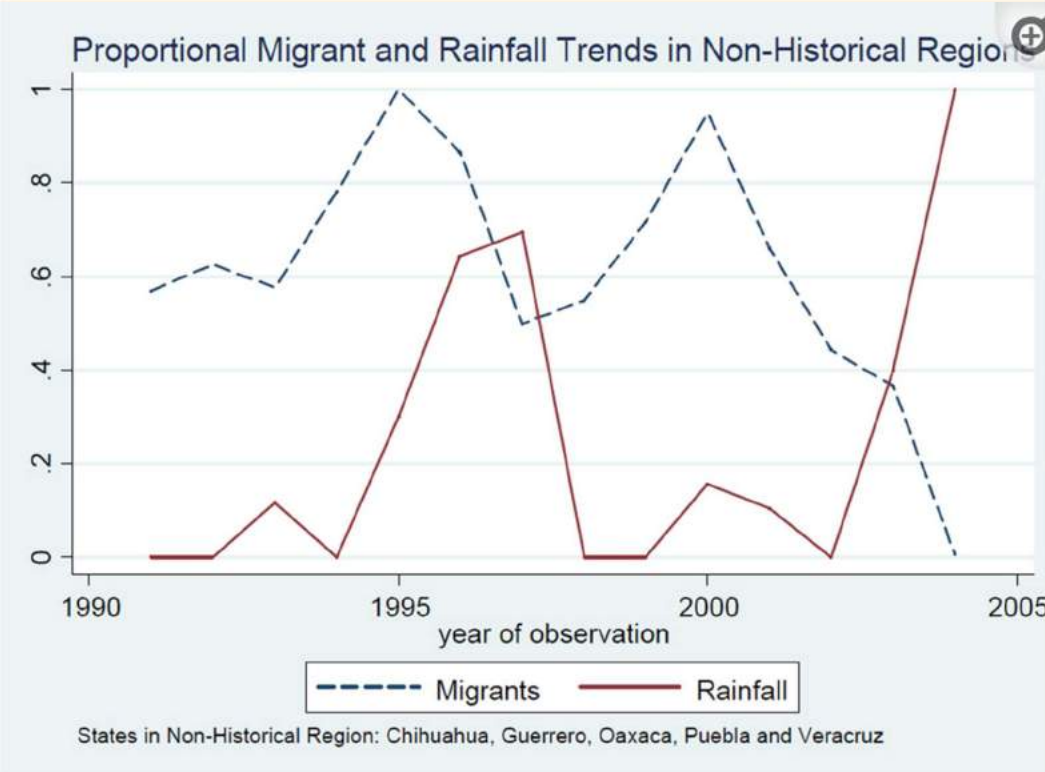
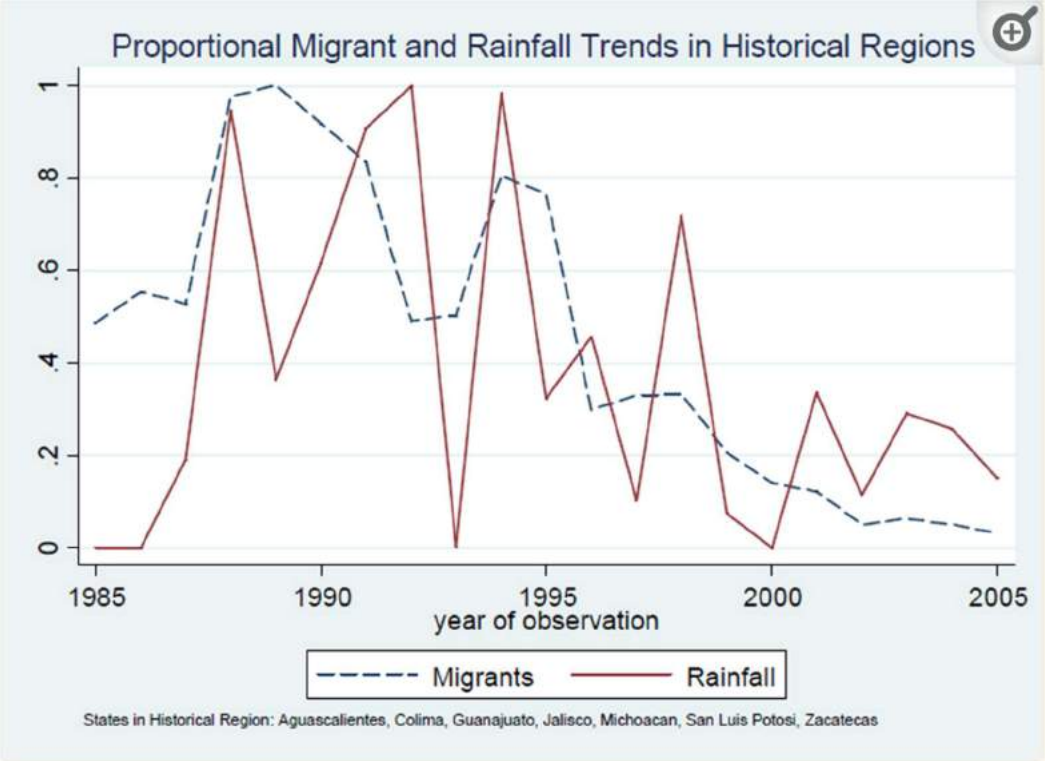
Research question:

Does rainfall impact migration into the United States from Mexico?

Methods and findings:

The researchers model the association between in-state rainfall and USB migration from Mexico. data is pulled from 66 communities surveyed by the Mexican migration project. Household level variables included access to human capital, financial capital, physical capital, and social capital.

Investigators graph migration and precipitation trends over time, by state.



Hunter, L. M., & Simon, D. H. (2023). Time to mainstream the environment into migration theory? *International Migration Review* 57(1), 5-35.
<https://journals.sagepub.com/doi/full/10.1177/01979183221074343>

Rationale:

Migration researchers must reflect on the complexity of drivers and consider environmental change within the context of displacement.

Research question:

What are the environmental influences that affect migration, grounded in theory?

Methods and findings:

The integration of environmental factors into migration theory can elucidate policy needs that support adaptive capacities. This table below gives insight into migration environmental theory.

Table 1. Illustrative Environmental Dimensions of Migration and Links to Theory.

Theory	Example	Link to Environment	Example
Neoclassical	Lee (1966); Harris and Todaro (1970)	wage & market rent impacts; amenities & disamenities	Graves (1980); Beine and Parsons (2015)
Migration Systems	Mabogunje (1970); Massey (1988); de Haas (2010)	snowbirds & sunbirds; recovery migration following Hurricane Katrina	Litwak and Longino (1987); Fussell, Curtis and DeWaard (2014a)
Push-Pull	Lee (1966); Van Hear, Bakewell and Long (2018)	natural disasters, drought, wildfire, conflict	Strobl (2011); Nawrotzki and Bakhtsiyarava (2017)
New-Economics of Labor Migration (NELM)	Stark and Bloom (1985); Massey and Espinosa (1997)	ex ante risk mitigation strategy or ex post means of coping with environmental stress	Gray (2010); Riosmena, Nawrotzki and Hunter (2018)
World Systems Theory and Political Economy	Castles (2013); Wallerstein (1974); Wallerstein and Tompkins (1982); Zolberg, Suhrke and Aguayo (1989)	disproportionate climate impacts to global South; land degradation and colonial histories	Affi (2011); Afolayan and Adelekan (1999); IPCC (2018)

Issa, R., Sarsour, A., Cullip, T., Toma, S., Ruysen, I., & Scheerens, C. (2023). Gaps and opportunities in climate change, migration and health nexus: Insights from a questionnaire-based study of practitioners and researchers. *Journal of Migration and Health*, 7, 100171.

Rationale:

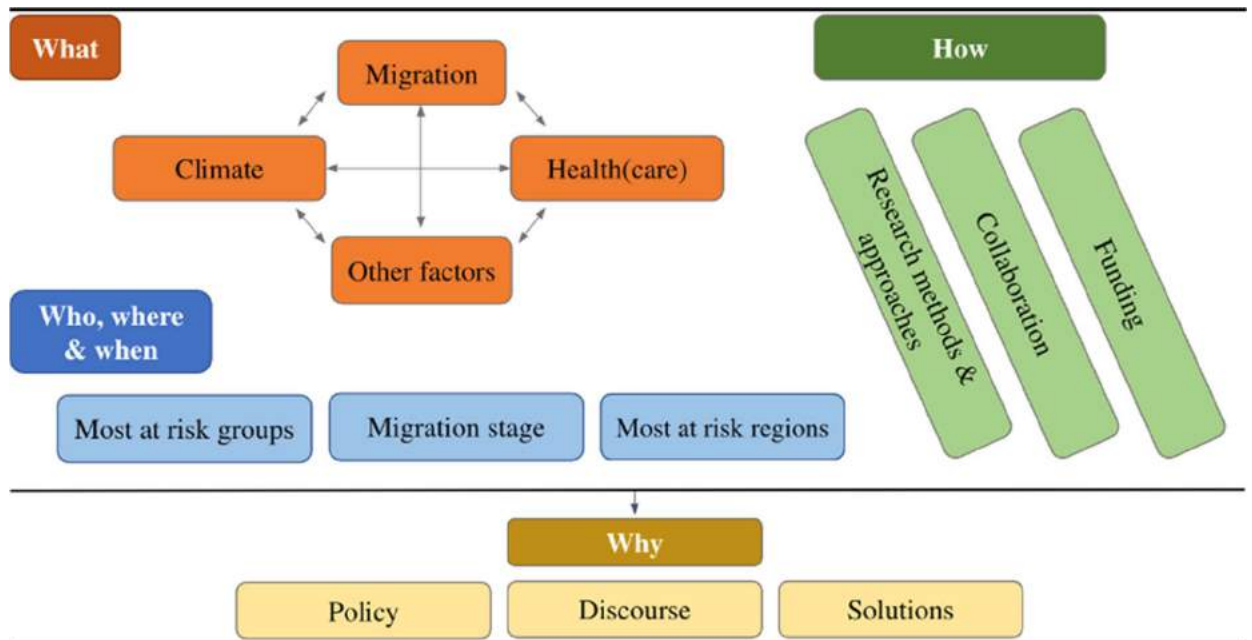
The purpose of this study is to examine gaps and opportunities in the nexus of climate, migration and health research.

Research questions:

1. What do you think are the research gaps in climate change, migration and health research?
2. What is the most important priority area in climate change, migration and health research?
3. What are the methodological challenges of this research?
4. What are the ethical challenges of this research?
5. What would help to advance research in this area?

Methods and findings:

Qualitative survey questionnaire utilized to survey 72 academics and practitioners working in climate, migration and health fields. Thematic coding identified gaps across health care delivery, intersections between climate change and migration, methodological and ethical challenges facing the most impoverished, and noted opportunities for improvements in grant funding to advance research. Determinants of health must be more clearly articulated in the research, noting dynamics of migration that examines internal displacement and immobile/trapped populations. Questionnaire may have responder bias, also it was shared on social media and therefore no way to ensure the expertise of the respondents.



<p>Research gaps and opportunities</p> <p>Health</p> <ul style="list-style-type: none"> - Health <i>Care</i>: health system needs, health workforce - Health <i>Outcomes</i>: disease groups e.g. mental health <p>Migration ↔ Climate impact pathways</p> <p>Most at risk groups Most at risk regions Migration journeys</p>	<p>Methodological challenges</p> <ul style="list-style-type: none"> - More intervention planning - Taking a planetary health lens - Working across disciplines - Advancing clarity and consensus on key definitions and terminology - Insufficient mixed methods - Lack of reliable data (particularly hard-to-reach populations) - Translating research into policy and practice
<p>Ethical challenges</p> <ul style="list-style-type: none"> - Lack of guidelines - Engaging with marginalised populations - Equity from a one-health perspective 	<p>Advancing research</p> <ul style="list-style-type: none"> - Collaboration: international, interdisciplinary, and intersectoral - Funding, investment, resource allocation

Iwamura, T., Guzman-Holst, A., & Murray, K. A. (2020). Accelerating invasion potential of disease vector *Aedes aegypti* under climate change. *Nature Communications*, 11(1), 2130.

Rationale:

Climate change is expected to exacerbate the risk of vector-borne diseases. “The objectives of the study are to design, develop and validate a phenology model incorporating the development of each life stage of *Ae. aegypti* and apply it to explore changes in life-cycle completions (LCC) intensity for this vector in response to past and projected climate changes globally.”

Research questions:

“Vector-borne diseases contribute to the global burden of disease, causing more than 1 billion infections, 1 million deaths, and 17 % of all death, illness, and disability on a global scale.” The model broadly reproduces the current known distribution of *Ae.*

Using this phenology model, will the intensity for mosquitos increase with predicted climatic events?

Methods and findings:

“LCC intensity for the midpoint of the time series (2000s as defined by the 2000–2004 average) was highly correlated with the global geographic distribution of *Ae. aegypti* (Fig. 1a), with the vast majority (99.9%) of occurrence records falling in locations with $LCC \geq 1$ (Fig. 1b–d). The area under the receiver operating characteristic curve (AUC) was 0.92 at the global scale. Kappa based on the confusion matrix was 0.80 when a $LCC > 10$ is set as a threshold.”

Using a mechanistic phenology model, the study examines the development of each life stage of *Ae. aegypti* and assesses changes in life-cycle completions that are seen to intensity in response to past and projected climate changes globally. “Results suggest that the world became ~1.5% more suitable per decade for the development of *Ae. aegypti* during 1950–2000, while this trend is predicted to accelerate to 3.2–4.4% per decade by 2050. Invasion fronts in North America and China are projected to accelerate from ~2 to 6 km/yr by 2050.”

Jessel, S., Sawyer, S., & Hernández, D. (2019). Energy, poverty, and health in climate change: A comprehensive review of an emerging literature. *Frontiers in Public Health*, 7, 357.

Rationale:

This review examines literature related to household energy poverty and health disproportionate burdens on vulnerable populations to meet household energy needs.

Research question:

What are the mediators and pathways that link energy insecurity to health?

Methods and findings:

The energy and security framework is a focus to help understand unmet household energy needs. This research examines inadequate household energy and how it relates to health, for example hypertension from a cold home or social vulnerabilities contribute to hardships. This research might inform policy makers on how energy insecurity, in addition to variables such as food insecurity, housing insecurity, structural and institutional racism, neighborhood segregation, educational inequity, and coming equity and other social issues are contributors to population health.

Koubi, V., Spilker, G., Schaffer, L., & Böhmelt, T. (2016). The role of environmental perceptions in migration decision-making: Evidence from both migrants and non-migrants in five developing nations. *Population and Environment*, 38, 134-163.

Rationale:

This paper examines migration decision making and individual perceptions of environmental change, sudden versus gradual, with a focus on: Vietnam, Cambodia, Uganda, Nicaragua, and Peru.

Research questions:

What are the factors that have culminated in your decision to migrate?

Survey data includes questions about household income, weather patterns/5 years, others in households that have experienced migration?

Methods and findings:

A survey questionnaire was given to both migrants and non-migrants regarding longer-term environmental events (droughts, floods, etc.)

Levy, B. S., & Patz, J. A. (2015). Climate change, human rights, and social justice. *Annals of Global Health*, 81(3), 310-322.

Rationale:

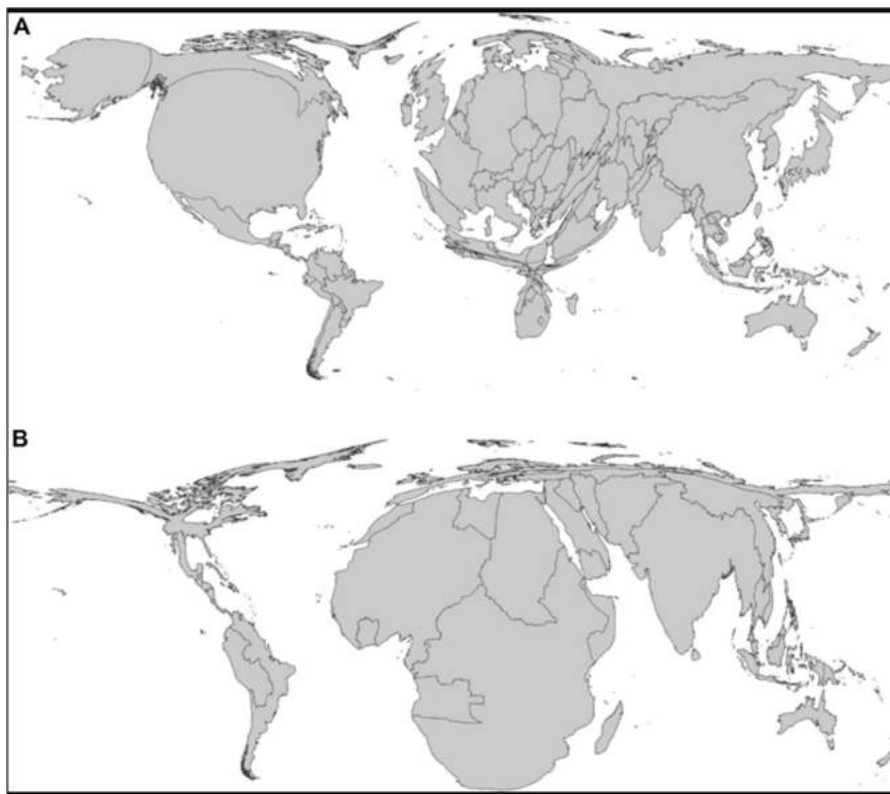
Human rights, social justice, and vulnerable populations' health are all compromised when a changing climate is not addressed by policy makers, a defining moral issue of the 21st century.

Research question:

What are adverse health consequences caused by climate change and how are they exacerbated by warming temperatures?

Methods and findings:

Addressing climate change is a health and human rights priority. Data-driven cartograms demonstrate (A) proportions of cumulative CO₂ emissions by country and (B) severity of consequences due to compromised health (malaria, malnutrition, diarrhea, and drownings).



McMichael, C. (2023). Climatic and Environmental Change, Migration, and Health. *Annual Review of Public Health, 44*, 171-191.

Rationale:

The authors review health impacts of climate change and implications on: 1) forcible displacement, 2) resettlement, 3) migration as an adaptive response.

Research question:

What are the climate change factors contributing to migration that impact human health?

Climate change migration often results in adverse health outcomes both for the displaced and for host populations, particularly enforced migration situations. When migration is used as an adaptive strategy, health risks are minimized and/or there may be possible health gains.

Methods and findings:

This risk assessment examines focused policy interventions that facilitate well-being and support social and economic development for people in places of origin and in places of destination. Human-induced climate change requires attention to support human rights and migration adaptation.

McMichael, A. J., & Lindgren, E. (2011). Climate change: Present and future risks to health, and necessary responses. *Journal of Internal Medicine, 270*(5), 401-413.

Rationale:

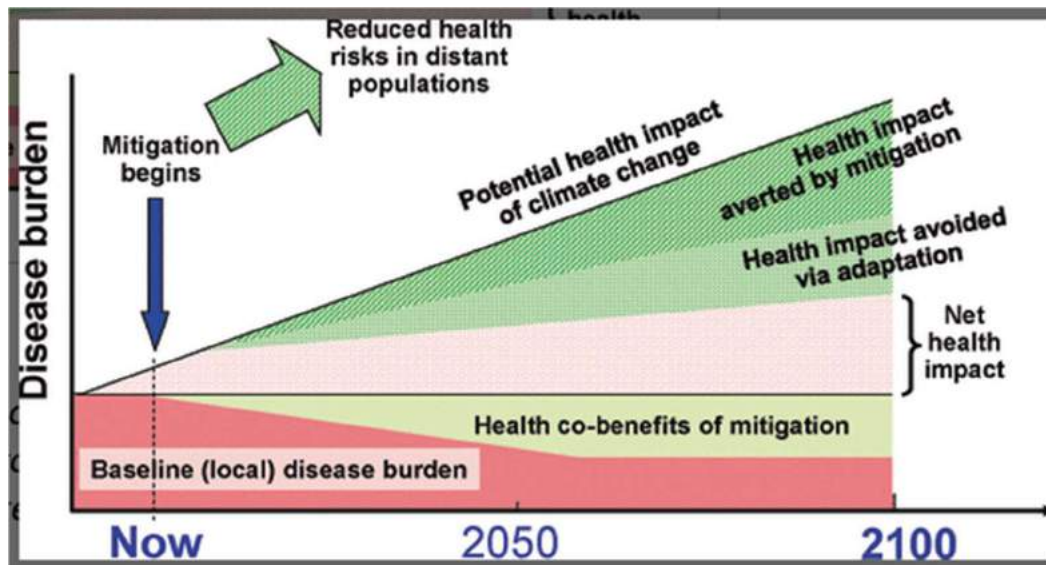
Human contributions to climate change have contributed substantially to affecting negative health outcomes. Future risk to health is a great concern and a policy response is needed.

Research questions:

- 1) What is the relationship between climate factors and health?
- 2) What are the impacts and scenario-based modeling of future changes in risk?

Methods and findings:

Understanding climate change helps with an awareness of risks to human health (food security, water flow, sea level rise, infrastructure damage, etc.)



More research is needed to educate health personnel and inform the public and policy makers about future risks needed to mitigate climate change.

Merone, L., & Tait, P. (2018). 'Climate refugees': Is it time to legally acknowledge those displaced by climate disruption? *Australia New Zealand Journal of Public Health*, 42(6): 508-509. doi: 10.1111/1753-6405.12849.

Rationale:

Rising sea levels and storm surges are potentially catastrophic for low-lying land masses, particularly the Pacific Islands; Kiribati and Tuvalu are predicted to be uninhabitable by 2050.

Research question:

How does the international community best support legal status for those displaced by climate disruption?

Methods and findings:

By 2050, there will be an estimated 200 million people globally who are displaced by climate change. Climate disruption poses significant problems for Australian neighbors, rising sea levels and adverse effects of flooding and drought will impact

water supplies. The people of Pacific Islands favor planned migration. Kiribati is home to 100,000 people and Tuvalu is home to 10,000. Migration is likely to be gradual over the next few decades. There is an urgent need for recognizing, resettling, and protecting climate refugees to ensure cultural identity, health and well-being. A treaty is needed to assist those adversely affected by climate disruption. International cooperation must accommodate those displaced by climate change; polluters are not the greatest affected by their actions.

Mora, C., McKenzie, T., Gaw, I. M., Dean, J. M., von Hammerstein, H., Knudson, T. A., Setter, R. O., Smith, C. Z., Webster, K. M., Patz, J. A. & Franklin, E. C. (2022). Over half of known human pathogenic diseases can be aggravated by climate change. *Nature Climate Change*, 12(9), 869-875.

Rationale:

There are numerous human pathogenic diseases and transmission pathways aggravated by climatic hazards, requiring an urgent need to address climate change. Infectious disease and heat-related mortality is attributed to recent human induced climate hazards.

Research question:

How does climate change affect human pathogenic disease?

Methods and findings:

Empirical examples of climatic hazards sensitive to greenhouse gas emissions are found to exacerbate disease. We found that 58% (that is, 218 out of 375) of infectious diseases confronted by humanity worldwide have been at some point aggravated by climatic hazards; 16% were at times diminished. Empirical cases revealed 1,006 unique pathways in which climatic hazards, via different transmission types, led to pathogenic diseases. Yet the failure to integrate available information prevents the greater understanding of the threat humans have contributed to that link to pathogenic diseases.

Fig. 3: Pathogenic diseases aggravated by climatic hazards.

From: [Over half of known human pathogenic diseases can be aggravated by climate change](#)

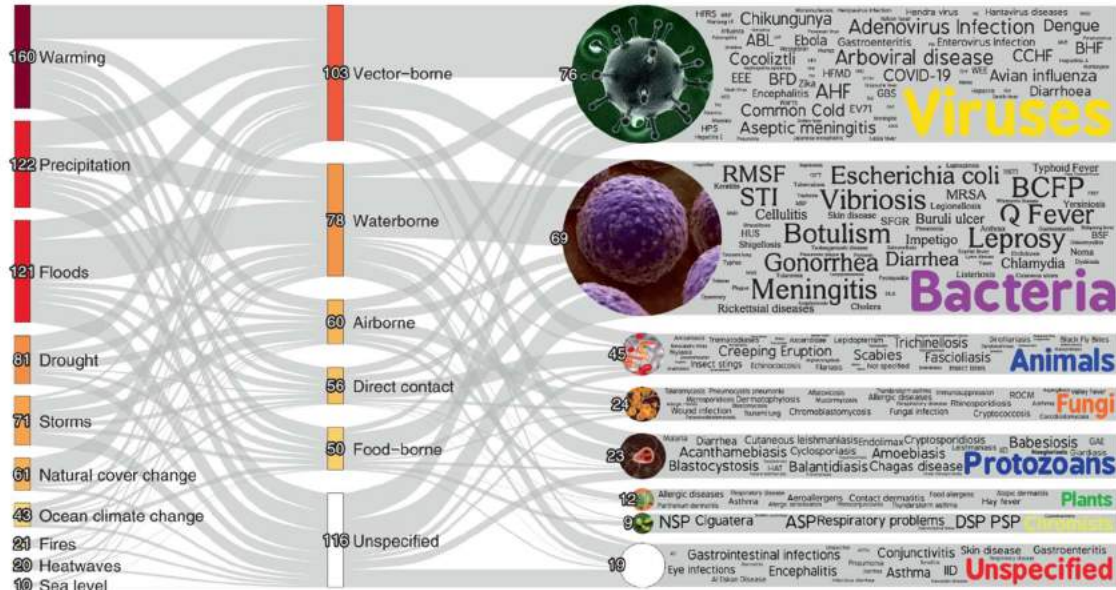
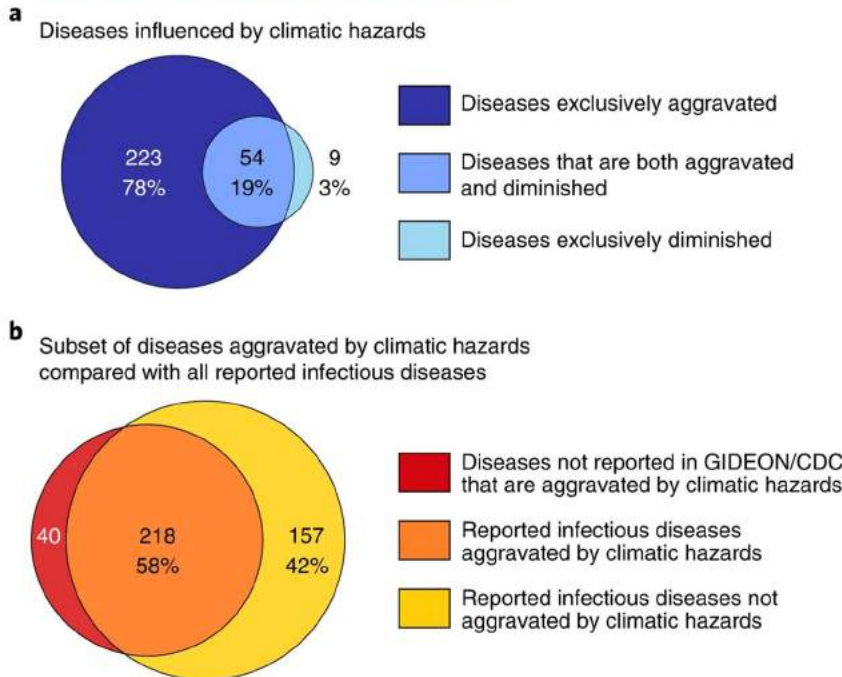


Fig. 4: Diseases affected by climatic hazards.

From: [Over half of known human pathogenic diseases can be aggravated by climate change](#)



a. Discrimination of pathogenic diseases between those aggravated and diminished by climatic hazards. **b.** Set of diseases aggravated by climatic hazards in comparison to all reported 'infectious' diseases known to have affected humanity (that is, an authoritative compilation of diseases known to have affected humanity in recent history by GIDEON and CDC; Methods).

Munshi, K. (2003). Networks in the modern economy: Mexican migrants in the US labor market. *The Quarterly Journal of Economics* 118 (2), 549-599.

Rationale:

The focus of this research is to identify job networks among Mexican migrants in the US Labor Market.

Research questions:

Do Mexican migration community networks have an impact on new migration into the US Labor Market?

Methods and findings:

Individuals were sampled at the US destination based on where they emigrated from in Mexico. Examining variation in the community's network over time can be used to identify effects on employment and occupational status. The research demonstrates that Mexican networks find jobs for its members and channel them into higher paying positions.

Padhy, S. K., Sarkar, S., Panigrahi, M., & Paul, S. (2015). Mental health effects of climate change. *Indian Journal of Occupational and Environmental Medicine*, 19(1), 3. doi: 10.4103/0019-5278.156997.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4446935/?report=printable>

Rationale:

Increasing temperatures and droughts increase rates of aggression, violence, stress, depression, suicides, and PTSD in humans.

Research questions:

- 1) Does climate change have an impact on physical health which leads to mental psychological distress?
- 2) Does ambient temperature have an effect on mental health?

Methods and findings:

No methods cited.

Researchers pose possible solutions to support mental health crises brought on by climate change. suggestions include: abolishing debt, economic support for farmers, creating

cooperatives to protect farmers, subsidies and guaranteed income during droughts, promoting health strategies like yoga and indigenous methods of wellness, improving community social capital, cultural belonging connections, and access to mental health services.

Patz, J. A., Frumkin, H., Holloway, T., Vimont, D. J., & Haines, A. (2014). Climate change: Challenges and opportunities for global health. *Journal of the American Medical Association*, 312(15), 1565-1580. doi: [10.1001/jama.2014.13186](https://doi.org/10.1001/jama.2014.13186)

Rationale:

The article reviews recent studies on health risks related to climate change discusses a potential benefit of efforts to mitigate greenhouse gas emissions.

Research questions:

What are health risks related to climate change?

Methods and findings:

Health professionals have an important responsibility to relate concerns and policies to patients that are affected by illnesses, due to climate change. Heat stress and economic consequences of reduced work capacity, respiratory disorders, air pollution and allergens, Asthma come infection disease, vector and waterborne diseases, childhood gastrointestinal disease, food insecurity, reduce crop yields, mental health disorders, post-traumatic stress disorder, depression, are all linked with climate natural disasters.

The authors suggest that air quality improvements from mitigating greenhouse gas emissions could potentially offset the cost of US and international carbon policies.

Puente, G. B., Perez, F., & Glitter, R. J. (2018). The effect of rainfall on migration from Mexico to the United States. *International Migration Review*, 50 (4). <https://doi.org/10.1111/imre.12>

Rationale:

The purpose of the research is to determine if climate change affecting rainfall conditions has an effect on migration from Mexico into the United States?

Research question?

What is the impact of rainfall on migration from Mexico to the United States?

Methods and findings:

The authors use NASA satellite data to examine rainfall, relative to key areas in Mexico, to determine migration levels in the United States. “A 20-percentage point higher-than-normal level of rainfall leads to a predicted 10.3% decrease in migration.”



Saverio, B., Christian, P., Catello, M., Maura, F., & Cegolon, L. (2023). Global health, climate change and migration: The need for recognition of "climate refugees." *Journal of Global Health, 13*.

Rationale:

The climate crisis is affecting individuals and global public health systems in every region of the world. Policy must be addressed.

Research question:

Climate refugees are defined as: “forgotten victims of climate change.”

What policy initiatives can be secured to protect human rights of those most affected by climate and migration?

Methods and findings:

In June 2022, 100 million people worldwide were recorded as displaced persons.

Researchers discuss upholding human rights and supporting adaptation and mitigation strategies. Recommendations include: investing in early warning systems and preparedness, investing in green economies, promoting inclusion, providing immunization initiatives and fostering cooperation via scaled-up climate action.

Smirnov, O., Gallya, L., Orbell, J., Zhang, M., & Xiao, T. (2023). Climate change, drought, and potential environmental migration flows under different policy scenarios. *International Migration Review* 57(1), 36-67. <https://doi.org/10.1177/01979183221079>

Rationale:

Researchers and policymakers consider drought as an underlying factor in migration. However, the relationship remains unclear. Climate models and computational data informatics (16 scenarios) are created to investigate internal and international migration to investigate the surge of drought induced migration and assess policy scenarios that would lend empirical evidence to suggest causes of migration and involuntary displacement.

Research questions:

How does drought affect migration?

What are the policy scenarios to mitigate involuntary displacement?

Methods and findings:

Applying insights from climate science and computational modeling to migration research, the authors examine drought-induced migration patterns and assess policy scenarios to mitigate displacement. See the following tables:

Table 3. Total Displacement at the State Level.

	RCP 8.5 2081– 2100 Share (mean)	RCP 8.5 2081– 2100 Share (low)	RCP 8.5 2081– 2100 Share (high)	RCP 8.5 /RCP 4.5 2041–2060	RCP 8.5 /RCP 4.5 2081–2100
WORLD	100.00%			1.27	1.97
1 Nigeria	7.82%	3.29%	12.35%	1.75	1.82
2 Egypt	5.17%	3.38%	6.96%	3.19	3.33
3 China	4.88%	0.98%	8.77%	1.64	1.85
4 Turkey	4.53%	3.32%	5.74%	1.95	3.95
5 Algeria	4.15%	3.47%	4.83%	1.34	2.60
6 Mexico	3.78%	2.55%	5.01%	1.42	2.39
7 Morocco	3.46%	2.96%	3.95%	1.27	3.08
8 Venezuela	3.19%	2.17%	4.21%	1.72	2.10
9 Indonesia	3.16%	0.95%	5.36%	1.10	1.95
10 India	2.98%	1.26%	4.69%	0.91	0.72
11 Syria	2.83%	2.20%	3.46%	2.35	3.28
12 Senegal	2.62%	1.68%	3.57%	2.07	3.72
13 Iraq	2.59%	1.59%	3.59%	1.26	2.06
14 Brazil	2.24%	1.55%	2.93%	1.41	1.96
15 Pakistan	2.18%	1.12%	3.25%	0.79	0.95
16 Guatemala	2.15%	1.19%	3.10%	2.08	2.72
17 Mali	2.12%	1.21%	3.03%	1.86	3.17
18 D.R. Congo	1.90%	1.11%	2.70%	0.53	1.64
19 Madagascar	1.85%	1.19%	2.52%	1.24	1.81
20 Iran	1.71%	1.13%	2.29%	1.07	2.32

Top 20 countries shown ranked by the share of the world's total displacement. The percentages/ratios are based on the mean monthly values from the ensemble of 16 climate models. The low and high values are based on SciPy Bayesian confidence intervals with alpha = 0.8.

Table 4. Total Migration Immobility at the State Level.

	RCP 8.5 2081– 2100 share	RCP 8.5 2041–60 / Present Ratio	RCP 8.5 2081–2100 / Present Ratio	RCP 8.5 /RCP 4.5 2041–2060	RCP 8.5 /RCP 4.5 2081–2100
WORLD	100%	2.14	5.91	1.26	2.48
1 Turkey	7.6%	4.84	14.94	1.99	3.97
2 Mexico	5.7%	5.30	12.94	1.49	2.79
3 Morocco	5.1%	7.58	26.62	1.32	3.14
4 Algeria	4.4%	5.58	15.99	1.36	2.79
5 Brazil	4.3%	3.19	7.25	1.28	1.87
6 Mali	3.9%	65.22	260.65	2.04	3.14
7 China	3.9%	0.71	1.50	1.79	1.99
8 Zambia	2.6%	3.59	17.24	0.88	2.24
9 Venezuela	2.5%	5.20	14.65	1.86	2.60
10 Zimbabwe	2.4%	1.45	7.57	0.59	3.09
11 Guinea	2.3%	5.23	23.43	1.37	3.74
12 Indonesia	2.2%	0.98	2.79	1.35	2.47
13 Mozambique	2.0%	2.30	6.35	0.76	1.51
14 Senegal	2.0%	9.29	32.66	1.92	3.43
15 Madagascar	1.9%	2.35	6.44	1.00	1.50
16 D.R. Congo	1.8%	2.04	4.69	0.59	1.41
17 Syria	1.8%	4.26	14.10	2.25	3.50
18 Angola	1.8%	2.55	9.63	1.46	2.91
19 Italy	1.6%	3.11	12.54	0.82	4.50
20 South Africa	1.6%	1.56	3.92	1.51	2.77

Top 20 countries shown ranked by the share of the world's total displacement. The percentages/ratios are based on the mean monthly values from the ensemble of 16 climate models.

Table 6. Top 20 External Migration Flows Under RCP 8.5 During 2008–2100 (in Thousands).

Rank	Origin	Destination	RCP 8.5	RCP 4.5	RCP 8.5—RCP 4.5 difference
1	India	China	2350.0	2574.3	–8.7%
2	Venezuela	Colombia	2115.9	1104.5	91.6%
3	Nigeria	Niger	1900.9	1232.4	54.2%
4	Pakistan	India	1840.7	2147.6	–14.3%
5	Morocco	Algeria	1653.5	760.4	117.5%
6	Egypt	Turkey	1588.4	638.4	148.8%
7	Algeria	France	1508.5	923.2	63.4%
8	Nigeria	Gabon	1487.2	547.2	171.8%
9	Morocco	Spain	1378.6	710.1	94.1%
10	Nigeria	Cameroon	1361.8	972.2	40.1%
11	Mexico	United States	1318.0	762.1	72.9%
12	Guatemala	Mexico	1303.3	506.0	157.6%
13	China	Vietnam	1131.4	708.9	59.6%
14	Turkey	Ukraine	1117.0	464.2	140.6%
15	Algeria	Italy	974.7	532.0	83.2%
16	Egypt	Libya	967.5	343.6	181.6%
17	Iraq	Saudi Arabia	953.5	602.2	58.3%
18	China	Philippines	880.0	524.9	67.7%
19	Nigeria	Mali	869.8	542.2	60.4%
20	Syria	Saudi Arabia	866.1	380.3	127.7%

The numbers are based on the mean value from the ensemble of 16 climate models and 0.001 as the maximum migration probability.

Smith, M. D. & Wesselbaum, D. (2022). Food insecurity and international migration flows. *International Migration Review* 56(2), 615-635.
<https://journals.sagepub.com/doi/abs/10.1177/01979183211042820>

Rationale:

The article examines the relationship between food and security and permanent international migration.

Research questions:

Examining international migration flow, what food insecurity exists as migrants arrive that pressures and destabilizes in-country equality?

Methods and findings:

Using a regression model, analysis examines migration flows from 198 origin countries to 16 OECD destination countries for 2014 and 2015. Researchers demonstrate a positive correlation between out-migration and within-country food insecurity at origin.

Watts, N., Adger, W. N., Ayeb-Karlsson, S., Bai, Y., Byass, P., Campbell-Lendrum, D., ... & Costello, A. (2017). The Lancet Countdown: tracking progress on health and climate change. *The Lancet*, 389(10074), 1151-1164.

Rationale:

This article tracks progress on health and climate examining global health challenges. A series of indicators are suggested to track collaboration with suggestions on methodologies and data sets– The purpose is to inform UNHCR, the World Health Organization and address the UN Sustainable Development Goals overtime.

Research questions:

How does climate change impact global health and how is this affecting health resilience and adaptation?

Methods and findings:

“The proposed indicator domains require further refinement and mark the beginning of an ongoing consultation process-from November 2016 to early 2017-to develop these domains, identify key areas not currently covered, and change indicators where necessary. This collaboration will actively seek to engage with existing monitoring processes, such as the UN Sustainable Development Goals and WHO's climate and health country profiles. The indicators will also evolve over time through ongoing collaboration with experts and a range of stakeholders and be dependent on the emergence of new evidence and knowledge.”

Wiederkehr, C., Ide, T., Seppelt, R., & Hermans, K. (2022). It's all about politics: Migration and resource conflicts in the global south. *World Development*, 157, 105938.
<https://www.sciencedirect.com/science/article/abs/pii/S0305750X22001280>

Rationale:

Large migration flows are anticipated within the global south, resulting from arm conflict, Global Environmental change, economic inequity. This research will look at case studies to examine the Nexus between migration, resource competition and conflict at an aggregate level in the global South.

Research questions:

What are contextual factors conducive to conflicts over renewable resources in rural immigration areas in the global south?

Methods and findings:

Qualitative comparative analysis is a set-theoretic method designed for system comparison and causal interpretation. The authors review 20 cases and apply qualitative comparative analysis to determine how conflict evolves over resources.

U.S. Climate Resilience Toolkit. <https://toolkit.climate.gov/>
<https://toolkit.climate.gov/region/great-lakes>

Rationale:

Michigan State University researchers created a toolkit for policy makers interested in mitigating climate change effects affecting the US great lakes region.

Research Gap

Scholarship on migration and climate change focuses on complex relationships (Boas., et al., 2022) and is happening in parallel to prevailing migration theories and empirical findings. Our objectives for this review article are to: 1) describe the knowledge gaps on climate change in the core migration literature, (2) identify the challenges to inclusion of climate change as a driver of past and future migrations; and (3) propose a conceptual framework for modeling climate change as a major driver of human migration as well as a context for other forces shaping migration. We conclude by suggesting how our framework could bridge critical issues in migration studies related to migrant health.

Conceptual Framework

