ACCSCIENCE PUBLISHING

International Journal of Population Studies

REVIEW ARTICLE

Governing mobility as adaptation: A bibliometric and thematic analysis of climate-related human mobility literature in the Southern African Development Community

Wonesai Workington Sithole*, Alice Ncube, and Abiodun Ogundeji

Disaster Management Training and Education Centre for Africa (DIMTEC), University of the Free State, Bloemfontein, Free State, South Africa

Abstract

Climate-related human mobility has become an important field of inquiry, yet its treatment across migration, adaptation, and governance scholarship remains conceptually fragmented. This study maps the development, intellectual structure, and substantive orientation of Scopus-indexed research on climate-related human mobility in the 16 member states of the Southern African Development Community (SADC). It combines bibliometric performance analysis, VOSviewer science mapping, and structured thematic interpretation of 1,116 publications retrieved from the Scopus database from its inception to December 31, 2025. The analysis examines publication growth, influential sources, citation structures, co-authorship networks, co-citation patterns, bibliographic coupling, and keyword co-occurrence, while also interpreting how the literature frames mobility forms, climate stressors, adaptation, governance, justice, geographical coverage, and knowledge leadership. Findings show that the field has expanded rapidly since 2020 but remains geographically and epistemically uneven, with South Africa, Tanzania, Zimbabwe, and Mozambique dominating visibility while several smaller, island, and less research-intensive SADC states remain marginal. The intellectual structure is multidisciplinary, drawing on climate science, environmental change, vulnerability, livelihoods, disaster-risk, and migration scholarship. Adaptation, resilience, vulnerability, livelihoods, displacement, and resettlement are prominent in the indexed conceptual structure, whereas governance, justice, and immobility have lower visibility. Guided by a governance-mediated mobility framework, the article interprets migration, displacement, relocation, and immobility as outcomes whose adaptive significance depends on institutions, rights, resources, land tenure, participation, social protection, and destination conditions. The study contributes a SADC-specific geographical and epistemic map of the field and a governance-oriented research agenda, while distinguishing bibliometric evidence from the normative implications developed through the conceptual framework.

Keywords: Climate change; Climate mobility; Governance; Adaptation; Southern African Development Community

***Corresponding author:**
Wonesai Workington Sithole
(2009103355@ufs4life.ac.za)

Citation: Sithole, W. W., Ncube, A., & Ogundeji, A. Governing mobility as adaptation: A bibliometric and thematic analysis of climate-related human mobility literature in the Southern African Development Community. *International Journal of Population Studies*. https://doi.org/10.36922/IJPS026300185

Received: July 24, 2026

Revised: October 21, 2026

Accepted: October 22, 2026

Published online: November 26, 2026

Copyright: © 2026 Author(s). This is an Open-Access article distributed under the terms of the Creative Commons Attribution License, permitting distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher's Note: AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Climate change is reshaping the ecological, social, and economic conditions under which people decide whether to move, remain, return, or relocate. Rising temperatures, shifting rainfall regimes, recurrent droughts, floods, tropical cyclones, sea-level rise, and land degradation affect agricultural production, water security, housing, health, food systems, and livelihoods (Tirivangasi, 2024; Tirivangasi *et al.*, 2021). Yet these pressures do not translate mechanically into migration. Human mobility emerges through interactions among environmental change, household resources, labor markets, political conditions, social networks, development inequalities, border regimes, and longer histories of movement (Anderson & Silva, 2020; Mueller *et al.*, 2020; Xiao *et al.*, 2022). The Intergovernmental Panel on Climate Change (2022) likewise emphasizes that climatic conditions interact with economic, social, political, and demographic processes in shaping migration and displacement. Climate change should therefore not be treated as a singular or independently measurable cause of migration. Recent displacement underscores the scale of contemporary mobility and the need for conceptual precision. The Internal Displacement Monitoring Centre (2026) recorded 29.9 million disaster-related internal displacements in 2025. At year-end, 82.2 million people were living in internal displacement from disasters and conflict. These indicators measure different phenomena: the former counts movements, including repeated movements, whereas the latter estimates people living in displacement. Disaster displacement should not automatically be labeled climate-induced migration. Hazards interact with exposure, vulnerability, preparedness, and governance, and not every disaster event can be directly attributed to anthropogenic climate change. Longer-term modeling nevertheless signals substantial mobility pressures. Under a pessimistic climate and development scenario, sub-Saharan Africa could experience up to 85.7 million internal climate migrants by 2050. This is a scenario-based projection, not a forecast, for the Southern African Development Community (SADC) region (World Bank, 2021).

Empirical work from the SADC region already demonstrates diverse climate-mobility pathways. Research has examined weather-related rural-to-urban migration in Mozambique (Anderson & Silva, 2020), gendered drought responses in Malawi (Becerra-Valbuena & Millock, 2021), and climate and network effects on internal migration in South Africa (Xiao *et al.*, 2022). Studies in Namibia show that climate migration can produce both benefits and dis-benefits across rural and peri-urban settings (Thorn *et al.*, 2023). Work from Zimbabwe further highlights border-region (im)mobilities and the institutional conditions surrounding post-disaster relocation (Ngulube *et al.*, 2024; Spiegel *et al.*, 2023). For population studies, the central issue is therefore not simply whether climatic stress produces movement, but how mobility and immobility vary across places, social groups and institutional settings. Yet this evidence remains dispersed across migration studies, climate adaptation, disaster research, development studies and governance. Its regional distribution, conceptual organization and knowledge-production structures within SADC have not been assessed systematically. A SADC-specific synthesis is therefore needed to identify geographical and epistemic concentration and to examine how adaptation, governance and differentiated mobility are represented across the field.

This study addresses that regional and conceptual gap by combining bibliometric performance analysis, VOSviewer science mapping, and structured thematic analysis of Scopus-indexed scholarship on climate-related human mobility in the SADC region through December 31, 2025. It examines publication growth, disciplinary orientation, citation influence, geographical coverage, and the intellectual structure of the field. It also analyzes how migration, displacement, relocation, and immobility are framed in relation to adaptation and maladaptation. Further attention is given to governance, justice, population groups, mobility forms, and geographical settings. Knowledge production is examined through intra-regional, South–South and North–South collaboration patterns. Together, these dimensions allow the study to assess both the structure of the literature and the substantive assumptions through which climate-related mobility is interpreted.

The analysis is guided by a governance-mediated mobility framework. The framework links climate and environmental pressures to structural inequalities, household conditions, and mobility capabilities, while treating governance as a condition shaping adaptation and justice outcomes. The paper makes three contributions beyond existing global and Global South reviews. Empirically, it provides a SADC-specific map of national visibility and regional concentration. Epistemically, it distinguishes the geographical focus of research from the institutional location of authorship, allowing knowledge leadership and collaboration patterns to be examined. Conceptually, it uses governance as an analytical lens connecting climate pressures, mobility capabilities, and adaptation outcomes. Methodologically, it combines bibliometric science mapping with structured thematic interpretation. This design shows what the field publishes and cites while also identifying how adaptive mobility is framed, which contexts remain less visible, and which

institutional relationships shape the regional knowledge agenda.

1.1. Background and conceptual framework

This study consequently adopts "climate-related human mobility" as its overarching concept. The term accommodates a continuum that includes voluntary and involuntary migration, temporary and permanent movement, seasonal and circular mobility, disaster displacement, evacuation, planned relocation, resettlement, return and immobility. It also avoids implying that climate change can ordinarily be isolated from the multiple drivers shaping mobility decisions. This distinction is important because early maximalist narratives often represented environmental change as producing predictable waves of "climate refugees." Such claims have been criticized for environmental determinism, weak causal assumptions, and the securitization of migrants (Cattaneo *et al.*, 2019). Reviews of empirical research instead show considerable heterogeneity: climatic shocks may increase, redirect, delay, or reduce migration depending on hazard type, time horizon, wealth, livelihood structure, political context, and the resources required to move (Black *et al.*, 2011; Nyahunda *et al.*, 2021). Climate change may therefore alter established mobility systems without creating an entirely separate category of migrant.

A further conceptual shift has recast mobility from an adaptation failure into a possible adaptation strategy. Migration can diversify income, spread livelihood risks, improve access to employment and services, and generate financial, social and knowledge remittances. It may also enable people to leave locations where in-situ adaptation has become insufficient. Black *et al.* (2011) argued that mobility can create opportunities for coping with environmental change. Subsequent scholarship has qualified this position. Environmental mobility is highly heterogeneous and context-dependent (Hoffmann *et al.*, 2021), and its adaptive potential cannot be assessed without attention to immobility, disconnection, and translocal exposure (Sakdapolrak *et al.*, 2024). This perspective recognizes agency and draws attention to labor migration, seasonal movement, and translocal livelihoods through which households manage climatic and economic variability. Adaptive outcomes, however, depend on whose well-being is assessed, over what period, and at what spatial scale. A household may gain remittance income while a migrant encounters insecure work, housing, or services at destination (Vinke *et al.*, 2020).

Immobility must also be included within this analytical field. Some people remain because they possess resources, attachments, and institutional support for local adaptation. Others remain because declining assets, restrictive policies, care responsibilities, disability, insecure tenure, or marginalization prevent movement. The concept of trapped populations highlights those exposed to environmental risk who cannot move, but it can also collapse diverse preferences and constraints into a deficit category (Ayeb-Karsson *et al.*, 2018). Mobility and immobility may coexist within households and alternate over time. Focusing only on observed migrants therefore overlooks those who wish to move but cannot, those who deliberately remain, and those whose ability to stay safely is being eroded. These differentiated outcomes establish governance as an important analytical problem. Governance refers here to the institutions, laws, policies, political relationships, and decision-making processes through which mobility risks, opportunities, and resources are distributed. It operates before movement through adaptation investment, preparedness, land tenure, and early warning. During movement, it includes evacuation, documentation, border management, and protection; after movement, it includes housing, employment, services, integration, return, and compensation. Governance also shapes participation in relocation decisions and the recognition of different forms of knowledge and loss. The United Nations Framework Convention on Climate Change (2024) encourages states to integrate human mobility into national adaptation plans and related climate-planning instruments. The International Organization for Migration (2026) similarly places climate mobility within longer-term planning rather than only post-crisis response.

The phrase "governing mobility as adaptation" therefore does not assume that governments should promote movement as a universal climate solution. It directs attention to the conditions under which people can exercise meaningful choices among moving, staying, returning, and relocating, and to the distribution of benefits and harms arising from those choices (Tirivangasi, 2024). This framing links adaptation to justice. Distributional justice concerns access to finance, infrastructure, land, services, and secure destinations. Procedural justice concerns participation, consent, and accountability in decisions such as planned relocation. Recognitional justice asks whether policies respect distinct identities, histories, local knowledge systems, and place attachments. Reparative questions arise where communities experiencing displacement have contributed little to the emissions-producing climatic risks. Governance can consequently enable adaptive mobility, but it can also produce coercive relocation, maladaptive outcomes, unsafe immobility, and unequal exposure. These issues are especially significant in the SADC. SADC comprises 16 member states: Angola, Botswana, Comoros, the Democratic Republic of Congo,

Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia, and Zimbabwe (Southern African Development Community, n.d.). The region encompasses continental, coastal, island, urban, rural, and borderland contexts, as well as considerable diversity in political institutions, income levels, urbanization, and livelihood systems. It is exposed to recurrent droughts, floods, tropical cyclones, heat stress, rainfall variability, and coastal risks. The Intergovernmental Panel on Climate Change (2022) identified severe and interacting climate risks across Africa and notes that adaptation is constrained by finance, institutional capacity, inequality, and development deficits. Climate-related mobility in SADC also unfolds through historically established migration systems. Rural–urban, labor, cross-border, seasonal, and circular movements predate the contemporary climate crisis. Environmental stress enters these systems alongside employment, agrarian change, household strategies, border regimes, conflict, regional inequality, and destination vulnerability (Chigudu, 2024). Mpandeli *et al.* (2020) accordingly located Southern African migration within interlocking water, food, and socioeconomic insecurities rather than treating climate as an isolated driver. Mobility can redistribute rather than eliminate risk, while uneven legal protection, xenophobia, informal labor markets, and weak institutional coordination add governance complexity.

Despite this significance, scholarship on climate-related mobility in the SADC region remains difficult to assess as a coherent field. Relevant research is dispersed across migration studies, climate adaptation, disaster risk reduction, development studies, geography, public health, urban studies, agriculture, law, sociology, and political science. Different disciplines use overlapping terms, focus on different mobility forms, and apply different standards of causal explanation. Bibliometric analysis can measure publication growth, influential sources, citation structures, institutional participation, and collaboration networks, while science mapping can identify intellectual foundations through co-citation, current research fronts through bibliographic coupling, and conceptual relationships through keyword co-occurrence (Donthu *et al.*, 2021). VOSviewer provides a useful platform for constructing and visualizing such networks. However, bibliometric indicators cannot establish whether mobility is adaptive, whether relocation is participatory, whether immobility is voluntary or constrained, or whether governance is substantively addressed. Metadata relationships, therefore, require thematic interpretation.

Existing reviews provide an important foundation but leave a regionally specific opening. Milán-García *et al.* (2021) mapped international climate-change and migration research and documented the field's growth and interdisciplinary character. Khavarian-Garmsir *et al.* (2024) examined its themes and conceptual evolution. Aziz *et al.* (2025) focused on knowledge production in the Global South and foregrounded questions of authorship and epistemic representation. Systematic review evidence has also identified conceptual fragmentation, geographical imbalance, and uneven empirical evidence (Ghosh & Orchiston, 2022). Agenda-setting work calls for sharper attention to differentiated mobility and immobility (Simpson *et al.*, 2024; Zickgraf, 2021). These studies show that adaptation, justice and differentiated mobility are already established concerns. The novelty of a SADC-focused study therefore lies elsewhere. Global and Global South reviews cannot show how knowledge is distributed across SADC's national contexts or whether a small group of countries dominates regional visibility. They also cannot establish how adaptation and governance are framed within the regional corpus or whether research on SADC contexts is led mainly by SADC-based or external institutions.

1.2. Governance-mediated mobility as an adaptation framework

Figure A1 sets out the conceptual framework that organizes the analysis. The framework treats climate-related (im) mobility not as an outcome that is intrinsically adaptive or maladaptive, but as a process whose consequences are mediated by governance. Climate and environmental stressors, both slow- and rapid-onset, act on populations whose vulnerability, capability, and aspirations are unevenly distributed across the SADC region. These conditions generate a spectrum of responses ranging from labor and seasonal migration, through forced displacement and planned relocation, to immobility in its voluntary and involuntary trapped forms (Schewel, 2020; Zickgraf, 2021). Whether any of these responses expands or erodes people's security and longer-term well-being is determined not by movement itself but by the governance conditions under which it occurs (Black *et al.*, 2011).

The framework specifies five governance dimensions: institutional and policy coordination; procedural participation, rights and voice; distribution of resources, land tenure and social protection; recognition of diverse needs and groups; and reparative attention to loss and damage. These conditions can expand or constrain the adaptive possibilities of mobility and immobility. Outcomes then feed back into exposure, capability and future mobility decisions. The framework is used as an analytical interpretation of the literature and guides the discussion in **Section 4.1**. It is not treated as evidence that governance is already a dominant bibliometric feature of the field.

2. Data and methods

2.1. Research design and data source

This study employed a bibliometric review complemented by structured thematic content analysis to examine the development, knowledge structure, and substantive orientation of scholarship on climate-related human mobility in the SADC region. Bibliometric analysis enables the quantitative assessment of publication patterns, citation influence, and relationships among authors, institutions, countries, publications, and concepts. It commonly combines performance analysis with science mapping, thereby allowing researchers to examine both the productivity of a field and the intellectual, social, and conceptual structures through which knowledge develops (Milán-García *et al.*, 2021; Zupic & Čater, 2015). Bibliometric mapping alone cannot determine whether migration, displacement, relocation, or immobility is conceptualized as adaptive, maladaptive, coercive, or constrained. The study, therefore, supplemented bibliometric analysis with structured thematic coding of the included publications. This design connected publication and network patterns to the substantive treatment of adaptation, governance, justice, and knowledge leadership. We selected Scopus as the sole bibliographic database because of its multidisciplinary coverage and standardized metadata on publications, authors, affiliations, abstracts, keywords, citations, and cited references (Baas *et al.*, 2020). Its coverage was appropriate for a field spanning migration studies, environmental studies, geography, sociology, development studies, disaster research, political science, public health, agriculture, law, and urban studies. The use of one database also avoided inconsistencies in document classification, citation counts, and bibliographic fields that may arise when multiple databases are merged.

The data analyzed in this study were retrieved from the Scopus database. The full search query, inclusion and exclusioncriteria, thesaurus for term harmonization, and metadata of the final corpus are provided as Appendix. Raw Scopus records remain subject to Elsevier's subscription and licensing terms. The findings therefore represent Scopus-indexed scholarship rather than the totality of academic, policy and community-based knowledge on climate-related mobility in the region. Scopus was used as the single corpus source because it provides broad multidisciplinary coverage and structured metadata suitable for bibliometric performance analysis and science mapping (Mongeon & Paul-Hus, 2016). Comparative evaluations show that its journal coverage is wider than Web of Science and its metadata are more curated than fully open indexes such as Dimensions or Crossref (Visser *et al.*, 2021). A single curated database also improves internal consistency in document typing, author disambiguation, and citation linkage. The complete Boolean search string, field tags, filters, and export date, together with the term thesaurus used for synonym harmonization in VOSviewer, are reported in the **Supplementary Material** to ensure reproducibility.

2.2. Search strategy and eligibility criteria

The final search was conducted in Scopus on June 12, 2026, and covered publications issued up to December 31, 2025. Scopus launched in 2004 but includes retrospectively indexed records published before then; consequently, the corpus contains publications dating back to 1979. We excluded publications issued in 2026 because the year was incomplete at the time of the search, and including them would have created an artificial decline in annual publication output. The search strategy comprised three concept blocks. The first captured climate change and associated environmental pressures; the second captured human mobility, migration, displacement, relocation, resettlement, and immobility; and the third defined the geographical scope through SADC and its 16 member states. The search was conducted within the Scopus TITLE-ABS-KEY fields. Adaptation and governance were not included as compulsory search terms because their inclusion would have restricted the corpus to publications already using those concepts and would have prejudged the relationship that the study sought to investigate. Instead, the broader climate-mobility literature was retrieved, after which the thematic analysis assessed whether and how adaptation and governance were substantively addressed. Table 1 summarizes the three search components, database field, filters, and Boolean connections.

The combined search logic was: TITLE-ABS-KEY ((climate and environmental terms) AND (human-mobility terms) AND (SADC geographical terms)) AND PUBYEAR < 2026 AND (articles OR reviews OR book chapters). The search was piloted against a benchmark group of known publications on climate-related mobility in SADC countries. Broad terms such as migrate*, displace*, and relocate* were retained to maximize sensitivity, while eligibility criteria were used to distinguish substantive human-mobility scholarship from incidental uses of search terms. No language restriction was imposed during the initial search. Publications were retained where their titles, abstracts, or full texts provided sufficient information in English, French, or Portuguese to enable reliable eligibility assessment.

Eligibility was determined by focusing on each publication rather than by the mere occurrence of search terms. Table 2 summarizes the inclusion and exclusion criteria.

Table 1. Scopus search strategy

Search component	Search field and terms	Boolean connection
Database field	TITLE-ABS-KEY	Searches the title, abstract, and keywords
Climate and environmental pressures	"climate change" OR "climatic change" OR "climate variability" OR "climate-related" OR "climate-induced" OR "drought*" OR "flood*" OR "cyclone*" OR "sea level rise" OR "extreme weather" OR "desertification" OR "land degradation" OR "environmental change" OR "environmental degradation"	Connected to the mobility block using AND
Human mobility	"human mobilit*" OR "climate mobilit*" OR "environmental mobilit*" OR "migrat*" OR "displace*" OR "relocat*" OR "resettl*" OR "evacuation*" OR "immobility" OR "trapped population*" OR "managed retreat" OR "climate refugee*" OR "environmental refugee*"	Connected to the climate and geographical blocks using AND
Geographical scope	"Southern Africa" OR "Southern African Development Community" OR "SADC" OR "Angola" OR "Botswana" OR "Comoros" OR "Democratic Republic of the Congo" OR "DR Congo" OR "Congo-Kinshasa" OR "Eswatini" OR "Swaziland" OR "Lesotho" OR "Madagascar" OR "Malawi" OR "Mauritius" OR "Mozambique" OR "Namibia" OR "Seychelles" OR "South Africa" OR "Tanzania" OR "United Republic of Tanzania" OR "Zambia" OR "Zimbabwe"	Connected to the climate and mobility blocks using AND
Publication period	PUBYEAR < 2026	Limited the corpus to publications issued up to December 31, 2025
Document types	LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "re") OR LIMIT-TO(DOCTYPE, "ch")	Limited the results to journal articles, review articles, and book chapters

Table 2. Eligibility criteria

Criterion	Inclusion	Exclusion
Geographical focus	Substantive analysis of one or more SADC member states, the SADC region or a cross-border process involving SADC countries	Incidental mention of a SADC country without substantive analysis
Mobility phenomenon	Human migration, mobility, displacement, evacuation, relocation, resettlement, return, managed retreat or immobility	Animal, plant, microbial, cellular or genetic migration
Environmental relationship	Mobility examined in relation to climate change, climate variability, environmental change, extreme weather or disasters	Migration research without a substantive climatic or environmental dimension
Publication period	Publications issued up to December 31, 2025	Publications issued in 2026 or later
Document type	Journal articles, review articles and book chapters	Editorials, letters, notes, errata, conference abstracts and non-scholarly materials
Scholarly focus	Empirical, conceptual, methodological, legal, theoretical or policy research	Publications lacking sufficient analytical or scholarly content
Publication status	Final and non-retracted publications	Retracted records and duplicate versions

Abbreviation: SADC: Southern African Development Community.

Book chapters were included because relevant social-science and development research is not confined to journal articles. Where chapters lacked complete reference or keyword metadata, they remained eligible for descriptive and thematic analysis but were excluded from network analyses requiring unavailable fields.

2.3. Identification, screening, and data preparation

Figure 1 presents the identification and inclusion process. The Scopus search initially identified 1,285 records. Applying the publication-year restriction removed 63 records published in 2026, leaving 1,222 records. Limiting document types to journal articles, review articles, and book chapters removed another 98 records, leaving 1,124. Export cleaning removed seven duplicate Scopus EIDs and one record during revalidation, producing 1,116 records for title-and-abstract eligibility screening. No additional records were excluded at that stage because all records remaining after the documented restrictions and cleaning met the stated eligibility criteria. The final analytical corpus

therefore comprised 1,116 Scopus-indexed publications for bibliometric performance analysis, VOSviewer science mapping, and structured thematic analysis.

All records were exported from Scopus in comma-separated values format with citation information, bibliographic details, author names, institutional affiliations, abstracts, author keywords, indexed keywords, funding information, and cited references. The identification and selection process was documented through a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)-style flow diagram. The PRISMA literature-search extension (PRISMA-S) informed search reporting to improve transparency and reproducibility (Page *et al.*, 2021; Rethlefsen *et al.*, 2021). The original Scopus export was retained unchanged, while data cleaning was conducted in a separate working file. Records were checked for duplicate titles and digital object identifiers, early-access and final-version duplication, incomplete author names, and inconsistent institutional naming. Geographical variants such as Swaziland and Eswatini were harmonized for analytical purposes. A VOSviewer thesaurus file combined abbreviations, spelling variants, and genuine synonyms. For example, the "Southern African Development Community" was merged with "SADC." Generic terms such as article, study, method, and results were excluded where they added no conceptual value. Conceptually distinct terms, including migration, displacement, relocation, adaptation, resilience, governance, and immobility, were retained separately. The complete thesaurus was preserved as **Supplementary Material**.

2.4. Bibliometric and science-mapping analysis

Bibliometric performance analysis examined annual publication output, document types, subject areas, leading sources, productive authors, influential publications, participating institutions, author-affiliation countries, and citation patterns. Citation counts were interpreted as indicators of scholarly visibility rather than direct measures of research quality. Publication year was

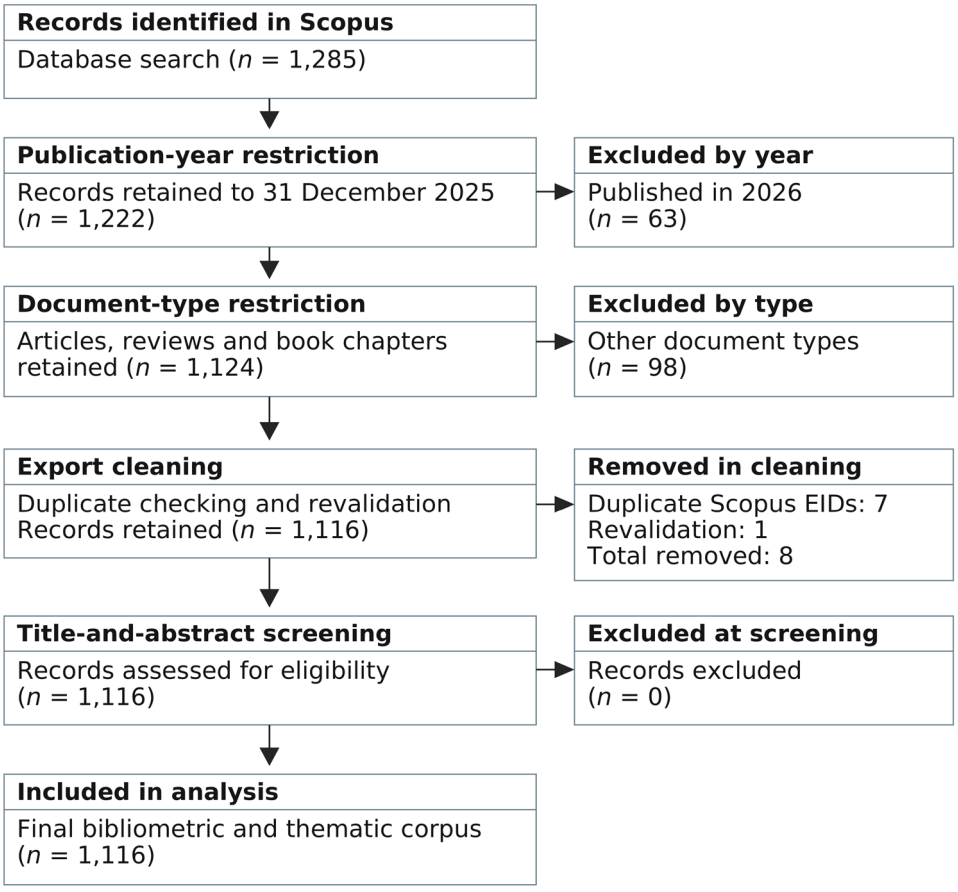

Figure 1. Identification, screening, and inclusion of the Scopus corpus (Preferred Reporting Items for Systematic Reviews and Meta-Analyses-style flow diagram)

considered because older publications have had more time to accumulate citations. Science mapping was conducted using VOSviewer (van Eck & Waltman, 2010). Fractional counting was used for principal collaboration and network analyses to reduce the disproportionate influence of publications with large numbers of authors, institutions, countries, keywords, or references (Perianes-Rodriguez *et al.*, 2016). Association-strength normalization was applied to construct the bibliometric maps. Table A1 summarizes the analytical procedures, units of analysis, and purposes. Preliminary thresholds were set at two publications for author, institutional, and country co-authorship networks, three occurrences for author-keyword co-occurrence, and five citations within the corpus for cited-reference co-citation. The thresholds were adjusted only where necessary to produce interpretable networks, and all final parameters were recorded. Author keywords were prioritized because they reflect terms deliberately assigned by publication authors. The clusters generated by VOSviewer were not automatically treated as substantive themes. They were interpreted through their most frequent terms, strongest links, central publications, abstracts and, where necessary, full texts. Cluster labels were therefore assigned through substantive interpretation rather than solely through algorithmic output.

2.5. Structured thematic analysis

Structured thematic analysis was used to examine the substantive content of the included publications, with the publication as the principal unit of coding. The coding framework was informed deductively by the governance-mediated mobility framework while remaining open to inductively emerging themes. Coding captured geographical location and spatial scale, climate or environmental stressors, mobility forms and temporalities, and degrees of agency or constraint. It also recorded adaptation and maladaptation framings, governance domains, justice dimensions, population groups, reported outcomes, methodological approaches, and the institutional location of research leadership. Adaptation and governance engagement were each assessed using a four-point ordinal scale. A score of zero indicated absence; one indicated a background mention; two indicated substantive examination in the analysis or findings; and three indicated a central theoretical, empirical, or policy concern. For example, a publication that referred to adaptation only in contextual background was coded 1. A publication that directly examined mobility as an adaptation response was coded 2, while work organized centrally around adaptation or governance was coded 3. Coding was performed by a single researcher using a documented codebook. Ambiguous cases were re-examined against the abstract and, where necessary, the full text, with decisions made against the explicit scale definitions rather than keyword presence alone.

The absence of independent inter-coder verification is acknowledged as a limitation (O'Connor & Joffe, 2020). Frequencies and cross-tabulations were used descriptively, alongside interpretive comparison. Inferential association tests were not used because the analysis characterizes the observed bibliometric corpus rather than estimating population parameters from a statistical sample. Bibliometric clusters were compared with thematic coding to assess whether algorithmically visible areas corresponded with substantive patterns. Knowledge leadership was assessed by distinguishing the empirical location of research from author affiliations. A publication was classified as SADC-led where its first or corresponding author was affiliated with an institution in a SADC member state. First and corresponding authorship were recorded separately. Collaboration was examined across single-country SADC, intra-SADC, SADC-other African, broader South-South and SADC-high-income-country relationships. Publications examining SADC contexts without an SADC-based co-author were identified separately. Because the study analyzed published bibliographic records and did not involve human participants or identifiable personal data, ethics approval and informed consent were not applicable.

Research gaps were not inferred solely from small or peripheral VOSviewer nodes. A gap was identified only where several indicators converged, including limited publication coverage, geographical underrepresentation, infrequent thematic codes, and substantive omissions detected through document reading.

2.6. Methodological limitations

The use of Scopus imposes a coverage limitation that is especially consequential for Southern African scholarship. Scopus and Web of Science under-represent journals published in Africa and the wider Global South, particularly in the social sciences and humanities (Tennant, 2020). Recent analysis likewise shows substantial regional disparities in database coverage (Asubiaro *et al.*, 2024; Asubiaro & Onaolapo, 2023). This indexing geography affects the visibility mapped in the present study. The findings should therefore be read as a map of internationally indexed scholarship rather than of all knowledge produced in the region. Concentration in a few national contexts may partly reflect indexing bias as well as underlying differences in research production. Future work could triangulate Scopus with Web of Science, Dimensions and African Journals Online to test the robustness of these patterns.

The exclusive use of Scopus provided a consistent bibliographic dataset but may have underrepresented locally published journals, books, theses, policy reports, community-based knowledge and publications in outlets not indexed by the database. This limitation reflects wider evidence that bibliometric results are shaped by database coverage, disciplinary representation and language indexing (Mongeon & Paul-Hus, 2016). Citation indicators may also privilege older publications, English-language research and institutions already occupying prominent positions in international academic publishing networks. The search strategy could not eliminate every problem created by inconsistent terminology and indexing. Some relevant studies may not use recognizable climate-mobility terminology in their titles, abstracts, or keywords, while the broad search terms produced false-positive records requiring manual removal. These limitations were addressed through benchmark testing, transparent eligibility criteria, and documentation of the search and analytical procedures.

3. Results

3.1. Publication growth and disciplinary development of climate-mobility scholarship

The results below report the bibliometric and thematic patterns. Interpretive synthesis and normative implications are developed separately in **Section 4**. Figure 2 shows the annual publication trajectory from 1979 to 2025. The corpus has a long but uneven publication history. Although Scopus launched in 2004, retrospective indexing means the dataset includes earlier publications, with the earliest record appearing in 1979. Publication output remained modest for several decades, increased during the 2010s, and accelerated after 2020. Overall, the corpus comprised 1,116 Scopus-indexed publications, with 2025 representing the peak year at 97 publications.

The temporal distribution suggests five broad phases in the development of the literature. The first phase, from 1979 to 2000, may be described as an early emergence period. It accounted for 138 publications, representing 12.4% of the corpus, with an average of 6.3 publications per year. During this period, the literature was comparatively sparse and dispersed across environmental, geographical, historical, and development-related concerns rather than organized around climate mobility as a coherent research field. The second phase, from 2001 to 2010, shows slow consolidation. This period produced 176 publications, or 15.8% of the corpus, with an average of 17.6 publications per year. The increase indicates that climate and environmental-change questions were becoming more visible within regional research, although the field had not yet developed the intensity seen in later years.

A more pronounced expansion occurred between 2011 and 2015, when 170 publications were recorded within only five years, representing 15.2% of the corpus and an average of 34 publications per year. This was followed by

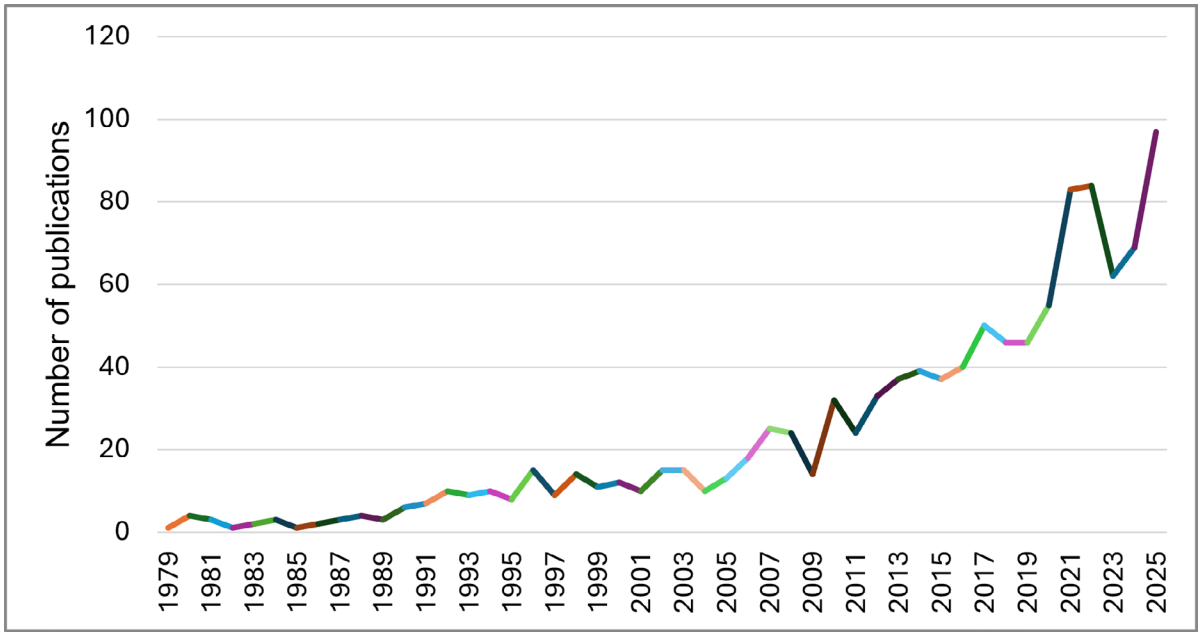

Figure 2. Annual publication growth of climate-related human mobility scholarship in the Southern African Development Community region, 1979–2025

further acceleration between 2016 and 2019, when 182 publications were produced over four years, accounting for 16.3% of the corpus and averaging 45.5 publications annually. These two phases suggest that climate-related mobility scholarship was becoming increasingly connected to broader debates on vulnerability, adaptation, resilience, livelihood change, disaster risk and development in Southern Africa. Rather than appearing suddenly as a discrete field, climate-mobility scholarship seems to have consolidated through adjacent literatures dealing with climate impacts, environmental risk, agrarian change, food and water insecurity, urbanization and displacement. The strongest growth occurred in the most recent period. Publications from 2020 to 2025 numbered 450, representing 40.3% of the entire corpus and averaging 75 publications per year. This recent surge demonstrates that climate-related human mobility has become a more visible and institutionally recognized area of scholarship. The increase coincides with wider academic and policy attention to climate adaptation, disaster displacement, climate justice, loss and damage, planned relocation, immobility and the integration of human mobility into climate planning. However, the bibliometric data do not establish that any single policy event, disaster or institutional process caused the rise in publications. The trend is better interpreted as evidence of cumulative field formation, in which climate mobility has become increasingly legible across multiple disciplines and policy arenas.

The document-type distribution also reflects the multidisciplinary character of the field. Journal articles dominated the corpus, with 948 publications (84.9%). Book chapters accounted for 113 publications (10.1%), while review articles comprised 55 (4.9%). The predominance of journal articles indicates that the field is mainly structured through peer-reviewed article-based knowledge production. The presence of book chapters nevertheless shows that relevant work also develops through edited and interdisciplinary collections. Overall, the publication pattern indicates growth from a dispersed knowledge base into a more recognizable area of inquiry. Publication volume alone, however, cannot establish whether adaptation, governance and justice are addressed consistently. The subsequent analyses examine those conceptual and intellectual structures.

3.2. Sources, influential publications, and geographical concentration

The publication-source profile shows that climate-related mobility scholarship in the SADC region is dispersed across environmental science, sustainability studies, development studies, geography, paleoenvironmental research, and African studies rather than being concentrated in migration-specific journals. The most productive outlets included Quaternary Science Reviews with 15 publications, the Sustainable Development Goals Series with 14 publications, and Paleogeography, Paleoclimatology, Paleoecology with 13 publications. Other visible outlets included PLOS ONE, Sustainability, Global Change Biology, Climate and Development, and the Journal of Southern African Studies. This distribution confirms the interdisciplinary nature of the corpus, but it also requires careful interpretation. Productivity in climate, ecological, or paleoenvironmental journals does not necessarily mean that human mobility is always the central analytical focus. Rather, it indicates that climate-mobility scholarship in the region is embedded within wider debates on environmental change, vulnerability, sustainability, livelihoods, and regional transformation. Citation influence followed a related but distinct pattern. The most cited publication in the corpus was "Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions," with 762 citations. Other highly cited publications addressed long-term climate variability, environmental degradation, urban resilience, vulnerability, and adaptation. These citation patterns suggest that the intellectual visibility of the corpus is shaped not only by migration studies but also by broader climate-impact and environmental-change literatures. This distinction is important because a highly cited publication may provide influential background knowledge on climatic stress, environmental variability, or vulnerability without necessarily offering a direct conceptual analysis of migration, displacement, relocation, or immobility. Accordingly, the 1,116-publication dataset should be interpreted as a search-defined bibliometric corpus at the climate-environment-mobility interface, not as 1,116 publications in which human mobility is necessarily the central research question.

Geographical visibility was uneven across the SADC region, as summarized in Figure 3. South Africa was by far the most frequently visible country, appearing in the title, abstract, or keywords of 379 records. Tanzania followed with 145 records, Zimbabwe with 143, Mozambique with 135, and Namibia with 85. Botswana, Madagascar, Malawi, and Zambia occupied a middle tier. Angola, the Democratic Republic of Congo, Lesotho, Seychelles, Mauritius, Eswatini, and Comoros were less visible. The regional term "Southern Africa" appeared in 214 records, whereas explicit use of "SADC" was limited.

This distribution shows that indexed climate-mobility scholarship is geographically concentrated rather than regionally balanced. South Africa's prominence may partly reflect its stronger representation in Scopus-indexed

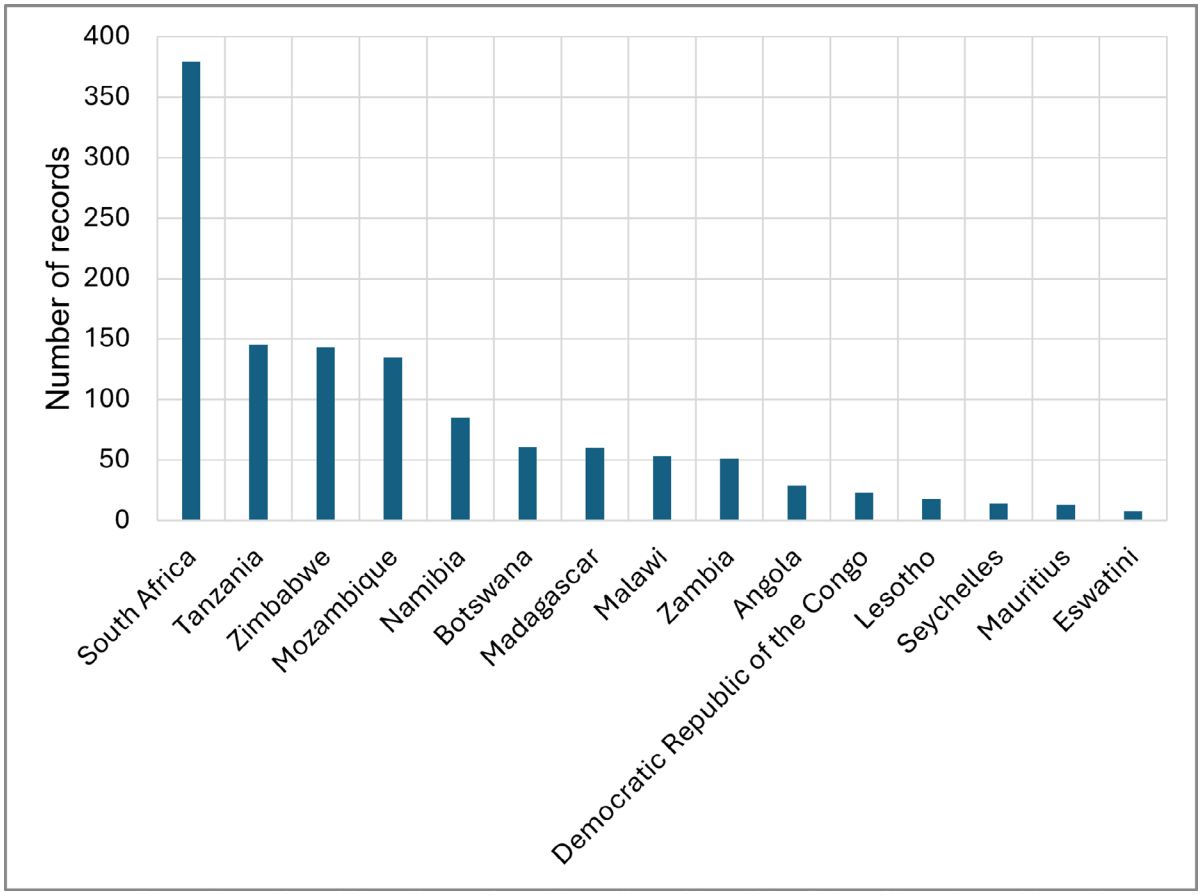

Figure 3. Southern African Development Community country visibility in title, abstract and keywords. Counts are not mutually exclusive because a publication may mention more than one country.

African research infrastructure (Asubiaro *et al.*, 2024; Asubiaro & Onaolapo, 2023), alongside its substantive importance in regional migration and climate research. Mozambique, Zimbabwe, and Tanzania are also prominent, whereas smaller island and landlocked states have lower visibility. The pattern should therefore be interpreted as uneven indexed visibility, not as a complete inventory of climate-mobility knowledge across SADC.

3.3. Authorship, collaboration, and knowledge leadership

The country co-authorship network in Figure 4 shows that knowledge production on climate-related human mobility in the SADC region is internationally connected but unevenly structured. South Africa occupies the most central position and is the largest SADC node. It is closely linked to research systems in the United States, Germany, France, the Netherlands, Australia, and the United Kingdom. Scopus-indexed scholarship on the region is therefore organized through extensive transnational collaboration rather than SADC-based authorship alone.

The network also shows that SADC countries occupy different positions within the collaboration structure. Zimbabwe, Tanzania, Mozambique, Namibia, Botswana, Zambia, Malawi, Madagascar, and the Democratic Republic of the Congo appear on the map, but they do not all have the same level of centrality. South Africa functions as the principal regional hub, while several other SADC countries appear as smaller nodes connected either through South Africa or through external partners. Mozambique, Zimbabwe, and Tanzania are visible as important country nodes, which is consistent with their prominence in the geographical distribution of the corpus. However, countries such as Eswatini, Lesotho, Comoros, Mauritius, and Seychelles are weakly visible or peripheral, suggesting that collaboration networks mirror the geographical unevenness identified in **Section 3.2**.

The presence of external countries as large and highly connected nodes is analytically important. The United States, Germany, France, the Netherlands, Australia, China, Sweden, Switzerland, Italy, and other non-SADC

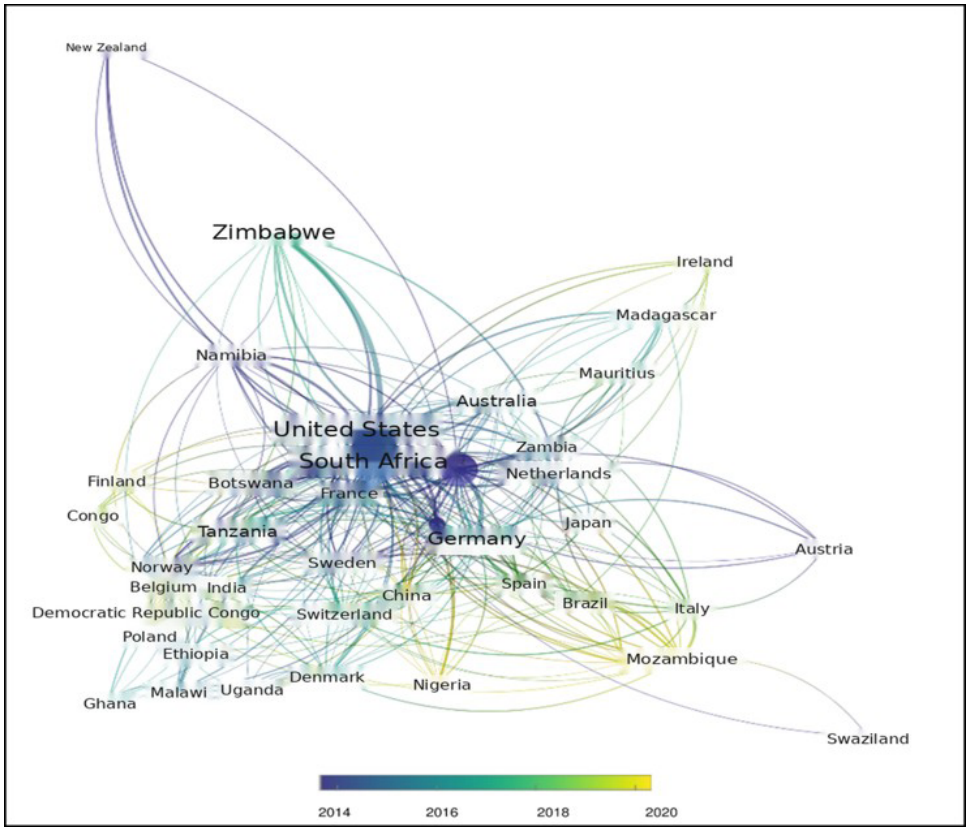

Figure 4. Country co-authorship network in climate-related human mobility scholarship on the Southern African Development Community region. Colors indicate average publication year; grey leader lines identify displaced labels.

countries appear as active participants in the collaboration network. This suggests that scholarship on climate-related mobility in SADC is produced through mixed knowledge networks that combine regional and extra-regional institutions. Such collaboration can strengthen the field by mobilizing resources, comparative expertise, publication capacity, and methodological diversity. At the same time, it raises questions about epistemic leadership, particularly when research concerning SADC contexts is led primarily by institutions outside the region. The overlay visualization suggests that some collaboration links involving external partners have become more visible in the recent period, while South Africa remains the enduring anchor of the network. The color gradient indicates temporal variation in collaboration patterns, with some countries associated with earlier average publication years and others appearing more prominently in later periods. This should not be interpreted as evidence that newer collaborations are necessarily more influential, but it does suggest that the internationalization of the field has continued alongside the recent growth in publication output.

These results highlight the distinction between empirical location and authorship location. A publication may examine drought, displacement, livelihoods or adaptation in a SADC country without being led by scholars institutionally located there. The co-authorship network therefore depicts a mixed field with substantial regional participation, especially through South Africa, alongside strong collaboration with high-income-country institutions. This pattern is consistent with wider concerns about uneven knowledge leadership in Global South climate-mobility research (Aziz *et al.*, 2025). Its implications are considered in **Section 4.2**.

3.4. Intellectual structure and research fronts

Figure A2 presents the co-citation structure of the corpus. The network comprised 441 cited references organized into 17 clusters. It reveals a broad and multidisciplinary intellectual base rather than a single migration-studies foundation. The principal knowledge traditions include climate science, paleoclimate research, vulnerability, environmental migration, livelihoods, disaster risk, adaptation, ecology, and regional environmental change. Several strongly connected references were located in

climate-variability and environmental-change scholarship. Foundational work on Southern African climatic variability, Indian Ocean dynamics, long-term rainfall variability, and paleoenvironmental change occupied central positions in the network. This indicates that the corpus is grounded partly in physical and environmental understandings of climatic stress, variability, and exposure, not only in social-science migration theory.

A second intellectual foundation concerns vulnerability, livelihoods, and adaptation. References on rural livelihoods, drought, food insecurity, water stress, and household responses connect environmental stress to human agency. This body of work situates mobility within livelihood diversification, vulnerability, and resource access rather than treating climatic change as an automatic cause of movement. A third foundation relates more directly to environmental migration, displacement, and resettlement. References on environmental migration, disaster displacement, flood-related resettlement, and post-disaster mobility provide the clearest conceptual basis for analyzing movement and immobility. The co-citation map also contains clusters that are not primarily about human mobility, including paleoclimate reconstruction, biodiversity, species distribution, geomorphology, and ecological responses to climate change. This reflects the breadth of the search-defined corpus and cautions against reading the network as a pure map of human climate-migration theory.

Bibliographic coupling provides a complementary view of contemporary research fronts. Unlike co-citation analysis, it groups publications that cite similar references. Appendix Figure A3 maps 429 coupled documents organized into 23 clusters. The most relevant research fronts include internal migration and climate stress, disaster displacement and relocation, livelihood adaptation, vulnerability, immobility, urban and regional resilience, and water-energy-food nexus planning.

The most directly relevant human-mobility cluster included publications on internal migration, trapped populations, climate-induced mobility, and mobility responses to drought and environmental stress. Studies such as those examining internal migration in South Africa, trapped populations in Zambia, environmental degradation and migration, and reduced migration under climate change in Malawi suggest that recent research is moving beyond linear climate–migration assumptions. Instead, the literature increasingly considers differentiated mobility capabilities, including the possibility that climate stress may reduce mobility when households lack the resources required to move. A second research front focuses on disasters, flooding, relocation, and resettlement. It includes work on flood risk, Tokwe-Mukosi displacement, disaster preparedness, state-led resettlement, and climate-related relocation in Mozambique, Zimbabwe, and Malawi (Mavhura, 2020). A third front links climate mobility to livelihoods, rural change, and adaptation through food security, water insecurity, natural capital, and urbanization. Together, the coupling patterns indicate a shift from broad foundations in climate variability and vulnerability towards more differentiated work on adaptation, immobility, disaster displacement, and relocation. Governance and justice are visible but remain less prominent than climate impacts, vulnerability, and adaptation.

3.5. Conceptual structure and thematic clusters

Figure A4 shows the author–keyword co-occurrence structure. The network is organized around climate change, migration, adaptation, vulnerability, livelihoods, resilience, and regional environmental risk. "Climate change" was the strongest keyword, appearing 156 times and recording the highest total link strength. It was closely connected to migration, adaptation, resilience, vulnerability, livelihoods, drought, floods, food security, and several SADC countries. The pattern confirms that climate-related human mobility is embedded in a wider conceptual field rather than organized through migration terminology alone. The first major thematic cluster concerns climate variability, paleoclimate, biodiversity, and regional environmental change. Keywords such as "South Africa," "Southern Africa," "Namibia," "Botswana," "Okavango Delta," "climate variability," "biodiversity," "paleoclimate," "Holocene," "Pleistocene," "Quaternary," "sea level," "conservation," and "geomorphology" show that part of the corpus is anchored in environmental and biophysical scholarship. This cluster helps explain why the field has a broader intellectual structure than migration studies alone. It provides evidence on climatic variability, ecological change, landscape transformation, and long-term environmental histories, but it is not always directly centered on human mobility. Its presence confirms the need to distinguish between environmental knowledge that contextualizes mobility and scholarship that directly theorizes migration, displacement, or immobility.

A second cluster links vulnerability, livelihoods, displacement, and disaster-related mobility. Keywords include vulnerability, livelihoods, displacement, floods, Cyclone Idai, resettlement, droughts, poverty, gender, smallholder farmers, Indigenous knowledge, Mozambique, Zimbabwe, and Malawi. A third cluster centers on adaptation, resilience, climate adaptation, governance, rural livelihoods, water, energy, management, and sustainable development. Adaptation appeared 45 times and resilience 33 times. Governance appeared only

six times in the author-keyword network, indicating lower indexed visibility as an organizing concept.

A fourth cluster links food security, rainfall, seasonality, livelihood, natural disasters, and health-related concerns. Keywords such as "food security," "food insecurity," "rainfall," "seasonality," "natural disasters," "public health," "epidemiology," "malaria," and "cholera" indicate that climate-related mobility is also connected to health, food systems, and disaster-risk pathways. This cluster broadens the field beyond migration decisions alone and shows that human mobility is embedded in changing livelihood, nutrition, health, and environmental conditions. The overlay visualization suggests that some of these terms, including public health, epidemiology, cholera, COVID-19, and water-related concerns, are associated with more recent average publication years. This points to an emerging connection between climate mobility, health risk, and compound vulnerability. A fifth cluster captures sustainability, remote sensing, urban planning, human rights, refugees, land degradation, deforestation, Madagascar, and mining. This cluster is more dispersed but conceptually important because it links environmental governance, rights-based language, urban planning, and resource extraction. The presence of "human rights" and "refugees" indicates some engagement with legal and protection-oriented concerns, yet these terms remain relatively peripheral compared with climate change, migration, adaptation, and vulnerability. Similarly, "urban planning" appears but does not dominate the network, suggesting that urban destination dynamics and planning-oriented responses remain underdeveloped relative to rural livelihoods, environmental stress, and disaster displacement. The keyword structure is most visibly organized around climate change, migration, adaptation, vulnerability, livelihoods, resilience, droughts, and floods. Displacement and resettlement are also visible, while governance, human rights, refugees, and urban planning are more peripheral. "Immobility" and "climate justice" do not appear as prominent threshold keywords in the main co-occurrence map. This indicates low visibility in the author-keyword structure, not substantive absence from the literature, because publications may discuss a concept without assigning it as an author keyword.

4. Discussion

Research on climate-related mobility in SADC has expanded rapidly while remaining dispersed across several analytical traditions. Publications from 2020–2025 account for 40.3% of the corpus, yet the co-citation and keyword networks connect several distinct environmental, livelihood, disaster, and migration literatures. Comparable reviews also identify conceptual and methodological heterogeneity in climate-migration research (Cattaneo *et al.*, 2019; Ghosh & Orchiston, 2022; Hoffmann *et al.*, 2021). The SADC findings extend these reviews by showing where regional scholarship is concentrated and how adaptation is more visible than governance in its indexed vocabulary. These patterns support closer examination of institutional mediation; they do not, by themselves, demonstrate that governance causes particular mobility outcomes. The interpretation developed below therefore brings the mapped patterns into dialogue with empirical studies and the framework in Figure A1.

4.1. Governance-mediated mobility as adaptation

Mobility can contribute to adaptation when it expands livelihood options without transferring unacceptable risks to migrants or those who remain. Black *et al.* (2011) identified migration's potential to support adaptation, while Vinke *et al.* (2020) cautioned that movement alone is insufficient evidence of an adaptive outcome. The prominence of adaptation, resilience and livelihoods in this corpus is consistent with that debate. In Namibia, Thorn *et al.* (2023) found that rural–peri-urban migration could reduce crop and income losses while increasing exposure to heat and insecure tenure. Their evidence also emphasizes circular movement and connections between origins and destinations. Sakdapolrak *et al.* (2024) similarly identified disconnectedness and simultaneous exposure across places as limits to migration's adaptive potential. Assessment should therefore follow linked households over time and examine employment, services, tenure and well-being at both ends of a migration trajectory, rather than classifying all movement as successful adaptation.

Displacement and relocation require separate assessment because reduced hazard exposure may coexist with livelihood losses and restricted choice. Research in rural Mozambique shows how flood-related resettlement can reorganize livelihoods (Arnall *et al.*, 2013), while the Tokwe–Mukorsi case demonstrates the institutional complexity of disaster-related displacement and resettlement in Zimbabwe (Mavhura, 2020). More directly, Ngulube *et al.* (2024) found that inadequate participation and failure to accommodate cultural attachments and livelihood concerns contributed to abandonment of reconstruction sites in Tsholotsho. These studies give substantive meaning to the governance dimension that is less visible in the keyword network: relocation outcomes depend on who participates, how land and resources are allocated, and whether livelihoods can be rebuilt. This interpretation also accords with Eriksen *et al.* (2021), whose review shows how adaptation interventions can reproduce vulnerability through inequitable participation and inadequate attention to local social conditions.

Immobility is an essential part of adaptation analysis because remaining can express either agency or constrained capability. Its low visibility among threshold keywords warrants further inquiry, but cannot establish its absence from the literature. Schewel (2020) explains how a focus on movement can obscure the structural and personal processes that sustain immobility; de Haas (2021) locates agency in the capability to choose where to live, including staying. The category of trapped populations also requires care because it can conceal differences in preferences and constraints (Ayeb-Karsson *et al.*, 2018). For the SADC research agenda, this implies studying the ability to remain safely alongside the ability to move. Relevant questions concern how assets, care responsibilities, legal status, tenure, social protection, and place attachment affect these options, and how they change after repeated shocks. These are propositions arising from the synthesis, rather than relationships estimated by the bibliometric analysis.

4.2. Research gaps, regional imbalances, and future research agenda

Geographical concentration limits how confidently evidence from highly visible countries can inform the region as a whole. South Africa, Tanzania, Zimbabwe, and Mozambique dominate this corpus, whereas several smaller, island, and less research-intensive states receive much less indexed attention. Piguet *et al.* (2018) showed that the geography of environmental-migration research reflects research locations, affiliations, and funding patterns as well as environmental vulnerability. The present distribution should likewise be treated as a map of scholarly visibility rather than a ranking of mobility pressures. Comparative studies across coastal, island, mountain, urban, and borderland settings could test how far the mechanisms identified in frequently studied countries travel to other SADC contexts. Such work should combine regional scholarship with locally produced and multilingual evidence, given the underrepresentation of African journals in major citation databases (Asubiaro *et al.*, 2024; Asubiaro & Onaolapo, 2023).

Future research should examine governance through specific institutional relationships and differentiated outcomes. The contrast between adaptation's prominence and governance's lower indexed visibility suggests a need to study land tenure, participation, social protection, adaptation finance, and destination services directly. These mechanisms should be assessed across gender, age, disability, livelihood, and legal status, rather than treating affected populations as homogeneous. Evidence on gendered drought-related migration in Malawi illustrates the value of this approach (Becerra-Valbuena & Millock, 2021). Research along the Zimbabwe–Mozambique border further demonstrates how disaster impacts intersect with land inequalities, pandemic disruption, and changing mobility constraints (Spiegel *et al.*, 2023). Recognitional justice also warrants attention to Indigenous knowledge and cultural heritage in adaptation planning (Tirivangasi & Kontinen, 2026). Longitudinal and comparative designs could distinguish immediate coping from sustained adaptation and identify who gains or loses over time, responding to the methodological concerns identified by Hoffmann *et al.* (2021).

Knowledge leadership should be investigated separately from international connectivity. South Africa's centrality and strong links to extra-regional institutions show collaboration patterns, but affiliation data do not reveal who selected research questions, controlled funding, or interpreted findings. This distinction is consistent with the separation of study geography, researcher location, and funding in Piguet *et al.* (2018), and with concerns about representation in Global South climate-mobility research (Aziz *et al.*, 2025). Future studies could combine authorship analysis with project-level evidence on funding, research roles and community participation. SADC-led partnerships and comparative work in less visible countries are therefore research priorities; the present network does not establish that external collaboration necessarily displaces regional agency.

4.3. Study limitations and policy implications

The review's conclusions are bounded by its database, search design, and analytical units. It maps Scopus-indexed scholarship and does not estimate migration prevalence, causal effects, or policy effectiveness. Comparative database studies document differences in journal and disciplinary coverage (Mongeon & Paul-Hus, 2016; Visser *et al.*, 2021), and African journals remain underrepresented (Asubiaro *et al.*, 2024). Lower visibility can therefore reflect indexing, language, and publication structures as well as research priorities. The broad search also connects human-mobility research with adjacent environmental and biophysical literatures. Consequently, network prominence cannot be interpreted as the prevalence of a concept in all SADC climate-mobility scholarship. Keyword thresholds can suppress infrequent terms, and publications may discuss governance or immobility without assigning those author keywords. These limitations qualify both the identification of gaps and comparisons between countries.

The thematic interpretation also requires caution because coding was conducted by one researcher. The structured coding scheme supports transparency but cannot substitute for independent assessment of interpretive consistency (O'Connor & Joffe, 2020).

Likewise, co-authorship networks describe relationships among publication affiliations rather than the distribution of decision-making authority. Future synthesis could triangulate Scopus with regional repositories and policy or community knowledge, and use independent coding checks. The present findings are best used to formulate questions for closer investigation, rather than to evaluate individual countries, institutions or adaptation programs.

Policy implications should focus on expanding meaningful choices among moving, staying, returning and relocating. This follows from the capability-based interpretation of mobility (de Haas, 2021) and the conditional relationship between migration and adaptation (Vinke *et al.*, 2020). The United Nations Framework Convention on Climate Change (2024) technical guide provides a basis for integrating human mobility into national adaptation planning, including displacement, labor migration, cross-border movement, and planned relocation. For SADC, the synthesis suggests examining coordination across adaptation, disaster risk reduction, social protection, land administration, urban services, and regional cooperation. These are priorities for policy design and empirical assessment, rather than evidence that a particular institutional arrangement already works across the region.

Relocation monitoring should assess participation, livelihood restoration, tenure security, services, and place attachment alongside physical safety. The Tsholotsho findings demonstrate why completion of housing cannot serve as the sole measure of recovery (Ngulube *et al.*, 2024). More broadly, Eriksen *et al.* (2021) show the risks of defining adaptation success without adequate attention to vulnerable groups' circumstances and participation. Support for those who remain is equally necessary: *in situ* adaptation and safe mobility options should be evaluated together, while preserving the distinction between voluntary and constrained immobility (Ayeb-Karsson *et al.*, 2018; Schewel, 2020). Applying these principles in particular SADC settings requires evidence on local preferences, institutional capacity, and outcomes over time.

5. Conclusion

This study mapped the development, intellectual structure, and thematic orientation of Scopus-indexed climate-related human mobility scholarship in the SADC region. The field has expanded substantially since 2020, but visibility remains geographically and epistemically concentrated in a small group of countries. The corpus is multidisciplinary and extends beyond publications centered exclusively on human mobility. Adaptation, vulnerability, resilience, livelihoods, displacement, and resettlement have stronger indexed visibility than governance, justice, and immobility. These differences represent patterns of bibliometric visibility rather than proof of substantive absence. The study's main conceptual contribution is to use governance as a lens for interpreting why similar forms of movement or immobility may produce different adaptation outcomes. Its methodological contribution is to combine science mapping with thematic interpretation so that metadata patterns are not mistaken for substantive conceptual engagement. For population and climate-mobility research, the findings identify priorities for stronger SADC-led knowledge production, evidence from underrepresented countries and groups, and direct analysis of the institutional conditions shaping mobility choices and outcomes. Policy recommendations remain propositions for future empirical testing because this study maps scholarship rather than evaluating SADC policies or institutions.

Acknowledgments

None.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors declare no competing interests.

Author contributions

Conceptualization: Wonesai Workington Sithole
Methodology: Wonesai Workington Sithole
Visualization: Wonesai Workington Sithole
Writing – original draft: Wonesai Workington Sithole
Writing – review & editing: Alice Ncube and Abiodun Ogundeji

Ethics approval and consent to participate

This study used secondary, publicly indexed bibliographic data and did not involve human participants or animals; ethics approval was therefore not required.

Consent for publication

Not applicable.

Availability of data and materials

The full Scopus search strategy, eligibility criteria, term thesaurus, and metadata of the final corpus are provided as **Supplementary Material**. The raw Scopus records are available from Elsevier's Scopus database subject to subscription and licensing terms.

Further disclosure

The authors prepared this paper completely. However, during the finalization of this manuscript, the authors used a generative artificial-intelligence assistant (Claude, Anthropic, USA) to support language editing and reference formatting. The authors reviewed and verified all content and take full responsibility for the conclusions presented.

References

Anderson, K. J., & Silva, J. A. (2020). Weather-related influences on rural-to-urban migration: A spectrum of attribution in Beira, Mozambique. *Global Environmental Change, 65*, 102193.

https://doi.org/10.1016/j.gloenvcha.2020.102193

Arnall, A., Thomas, D. S. G., Twyman, C., & Liverman, D. (2013). Flooding, resettlement, and change in livelihoods: Evidence from rural Mozambique. *Disasters, 37*(3), 468–488.

https://doi.org/10.1111/disa.12003

Asubiaro, T. V., Onaolapo, S., & Mills, D. (2024). Regional disparities in Web of Science and Scopus journal coverage. *Scientometrics, 129*(3), 1469–1491.

https://doi.org/10.1007/s11192-024-04948-x

Asubiaro, T. V., & Onaolapo, S. (2023). A comparative study of the coverage of African journals in Web of Science, Scopus, and CrossRef. *Journal of the Association for Information Science and Technology, 74*(7), 745–758.

https://doi.org/10.1002/asi.24758

Ayeb-Karsson, S., Smith, C. D., & Kniveton, D. (2018). A discursive review of the textual use of 'trapped' in environmental migration studies: The conceptual birth and troubled teenage years of trapped populations. *Ambio, 47*(5), 557–573.

https://doi.org/10.1007/s13280-017-1007-6

Aziz, M., Anjum, G., Nawaz, A. R., & Nadeem, I. (2025). Who speaks for climate migrants? A bibliometric analysis of knowledge production in the Global South. *Frontiers in Climate, 7*, 1658517.

https://doi.org/10.3389/fclim.2025.1658517

Baas, J., Schotten, M., Plume, A., Côté, G., & Karimi, R. (2020). Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative Science Studies, 1*(1), 377–386.

https://doi.org/10.1162/qss_a_00019

Becerra-Valbuena, L. G., & Millock, K. (2021). Gendered migration responses to drought in Malawi. *Journal of Demographic Economics, 87*(3), 437–477.

https://doi.org/10.1017/dem.2021.8

Black, R., Bennett, S. R. G., Thomas, S. M., & Beddington, J. R. (2011). Climate change: Migration as adaptation. *Nature, 478*(7370), 447–449.

https://doi.org/10.1038/478477a

Cattaneo, C., Beine, M., Fröhlich, C. J., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M., Millock, K., Piguet, E., & Schraven, B. (2019). Human migration in the era of climate change. *Review of Environmental Economics and Policy, 13*(2), 189–206.

https://doi.org/10.1093/reep/rez008

Chigudu, D. (2024). Towards a shared vision of peace, security, migration and climate change in Africa. *International Journal of Business Ecosystem & Strategy, 6*(6), 169–179.

https://doi.org/10.36096/ijbes.v6i6.615

de Haas, H. (2021). A theory of migration: The aspirations-capabilities framework. *Comparative Migration Studies, 9*(1), 8.

https://doi.org/10.1186/s40878-020-00210-4

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, 285–296.

https://doi.org/10.1016/j.jbusres.2021.04.070

Eriksen, S., Schipper, E. L. F., Scoville-Simonds, M., Vincent, K., Adam, H. N., Brooks, N., Harding, B., Khatri, D., Lenaerts, L., Liverman, D., Mills-Novoa, M., Mosberg, M., Movik, S., Muok, B., Nightingale, A., Ojha, H., Sygna, L., Taylor, M., Vogel, C., & West, J. J. (2021). Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance? *World Development, 141*, 105383.

https://doi.org/10.1016/j.worlddev.2020.105383

Ghosh, R. C., & Orchiston, C. (2022). A systematic review of climate migration research: Gaps in existing literature. *SN Social Sciences, 2*(5), 47.

https://doi.org/10.1007/s43545-022-00341-8

Hoffmann, R., Šedová, B., & Vinke, K. (2021). Improving the evidence base: A methodological review of the quantitative climate migration literature. *Global Environmental Change, 71*, 102367.

https://doi.org/10.1016/j.gloenvcha.2021.102367

Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability: Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

https://doi.org/10.1017/9781009325844

Internal Displacement Monitoring Centre. (2026). *Global report on internal displacement 2026*. IDMC, Geneva.

International Organization for Migration. (2026). *World migration report 2026*. IOM, Geneva.

Khavarian-Garmsir, A. R., Hajian Hossein Abadi, M., Sadeghi,

A., Rahimi, D., & Asadzadeh, A. (2024). Trends and future research in climate migration: A bibliometric analysis of forty years. *Environmental Hazards, 23*(3), 241–264.

https://doi.org/10.1080/17477891.2023.2265928

Mavhura, E. (2020). Dam-induced displacement and resettlement: Reflections from Tokwe-Mukorsi flood disaster, Zimbabwe. *International Journal of Disaster Risk Reduction, 44*, 101407.

https://doi.org/10.1016/j.ijdrr.2019.101407

Milán-García, J., Caparrós-Martínez, J. L., Rueda-López, N., & de Pablo Valenciano, J. (2021). Climate change-induced migration: A bibliometric review. *Globalization and Health, 17*(1), 74.

https://doi.org/10.1186/s12992-021-00722-3

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics, 106*(1), 213–228.

https://doi.org/10.1007/s11192-015-1765-5

Mpandeli, S., Nhamo, L., Hlahla, S., Naidoo, D., Liphadzi, S., Modi, A. T., & Mabhaudhi, T. (2020). Migration under climate change in Southern Africa: A nexus planning perspective. *Sustainability, 12*(11), 4722.

https://doi.org/10.3390/su12114722

Mueller, V., Gray, C., & Hopping, D. (2020). Climate-induced migration and unemployment in middle-income Africa. *Global Environmental Change, 65*, 102183.

https://doi.org/10.1016/j.gloenvcha.2020.102183

Ngulube, N. K., Tatano, H., & Samaddar, S. (2024). Factors impacting participatory post-disaster relocation and housing reconstruction: The case of Tsholotsho District, Zimbabwe. *International Journal of Disaster Risk Science, 15*(1), 58–72.

https://doi.org/10.1007/s13753-024-00536-y

Nyahunda, L., Chibvura, S., & Tirivangasi, H. M. (2021). Barriers towards sustainable development goal (SDG 5) on achieving gender equality and empowerment of women and girls in Nyanga rural district of Manicaland Province, Zimbabwe. *African Journal of Gender, Society & Development, 10*(3), 33–53.

https://doi.org/10.31920/2634-3622/2021/v10n3a2

O'Connor, C., & Joffe, H. (2020). Intercoder reliability in qualitative research: Debates and practical guidelines. *International Journal of Qualitative Methods, 19*, 1–13.

https://doi.org/10.1177/1609406919899220

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., & Chou, R. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71.

https://doi.org/10.1136/bmj.n71

Perianes-Rodriguez, A., Waltman, L., & van Eck, N. J. (2016). Constructing bibliometric networks: A comparison between full and fractional counting. *Journal of Informetrics, 10*(4), 1178–1195.

https://doi.org/10.1016/j.joi.2016.10.006

Piguet, E., Kaenzig, R., & Guélat, J. (2018). The uneven geography of research on environmental migration. *Population and Environment, 39*(4), 357–383.

https://doi.org/10.1007/s11111-018-0296-4

Rethlefsen, M. L., Kirtley, S., Waffenschmidt, S., Ayala, A. P., Moher, D., Page, M. J., Koffel, J. B., Blunt, H., Brigham, T., Chang, S., Clark, J., Conway, A., Couban, R., de Kock, S., Farrah, K., Fehrmann, P., Foster, M., Fowler, S. A., Glanville, J., . . . Young, S. (2021). PRISMA-S: An extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. *Systematic Reviews, 10*(1).

https://doi.org/10.1186/s13643-020-01542-z

Sakdapolrak, P., Borderon, M., & Sterly, H. (2024). The limits of migration as adaptation: A conceptual approach towards the role of immobility, disconnectedness and simultaneous exposure in translocal livelihoods systems. *Climate and Development, 16*(2), 87–96.

https://doi.org/10.1080/17565529.2023.2180318

Schewel, K. (2020). Understanding immobility: Moving beyond the mobility bias in migration studies. *International Migration Review, 54*(2), 328–355.

https://doi.org/10.1177/0197918319831952

Simpson, N. P., Mach, K. J., Tebboth, M. G. L., Gilmore, E. A., Siders, A. R., Holden, P., Anderson, B., Singh, C., Sabour, S., Stringer, L. C., Sterly, H., Williams, P. A., Meyer, A. L. S., Cundill, G., Rosengaertner, S., Nunow, A., Amakrane, K., & Trisos, C. H. (2024). Research priorities for climate mobility. *One Earth, 7*(4), 589–607.

https://doi.org/10.1016/j.oneear.2024.02.002

Southern African Development Community. (n.d.). *Member states*. SADC, Gaborone.

Spiegel, S. J., Kachena, L., & Gudhlanga, J. (2023). Climate disasters, altered migration and pandemic shocks: (Im) mobilities and interrelated struggles in a border region. *Mobilities, 18*(2), 328–347.

https://doi.org/10.1080/17450101.2022.2099756

Tennant, J. P. (2020). Web of Science and Scopus are not global databases of knowledge. *European Science Editing, 46*, e51987.

https://doi.org/10.3897/ese.2020.e51987

Thorn, J. P. R., Nangolo, P., Biancardi, R. A., Shackleton, S., Marchant, R. A., Ajala, O., Delgado, G., Mfune, J. K. E., Cinderby, S., & Hejnowicz, A. P. (2023). Exploring the

benefits and dis-benefits of climate migration as an adaptive strategy along the rural-peri-urban continuum in Namibia. *Regional Environmental Change, 23*(1), 10.

https://doi.org/10.1007/s10113-022-01973-5

Tirivangasi, H. M. (2024). Navigating planetary human entanglements through climate change-induced human mobility in Zimbabwe: An Afrocentric perspective from the Global South. *International Journal of Population Studies, 10*(4), 98–113.

https://doi.org/10.36922/ijps.2983

Tirivangasi, H. M., & Kontinen, T. (2026). Reclaiming Indigenous knowledge for sustainability: Afrocentric perspectives on Indigenous intangible cultural heritage and climate adaptation in rural Zimbabwe. *International Journal of Heritage Studies, 32*(3), 390–417.

https://doi.org/10.1080/13527258.2025.2595080

Tirivangasi, H. M., Nyahunda, L., & Mabila, T. (2021). Review of disaster response strategies for sustainable development in the wake of flood risks in Zimbabwe's rural-urban settlements. *Technium Social Sciences Journal, 26*, 968–983.

United Nations Framework Convention on Climate Change. (2024). *Technical guide on integrating human mobility and climate change linkages into relevant national climate change planning processes*. UNFCCC, Bonn.

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics, 84*(2), 523–538.

https://doi.org/10.1007/s11192-009-0146-3

Vinke, K., Bergmann, J., Blocher, J., Upadhyay, H., & Hoffmann, R. (2020). Migration as adaptation? *Migration Studies, 8*(4), 626–634.

https://doi.org/10.1093/migration/mnaa029

Visser, M., van Eck, N. J., & Waltman, L. (2021). Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. *Quantitative Science Studies, 2*(1), 20–41.

https://doi.org/10.1162/qss_a_00112

World Bank. (2021). *Groundswell part 2: Acting on internal climate migration*. World Bank, Washington, DC.

Xiao, T., Oppenheimer, M., He, X., & Mastrorillo, M. (2022). Complex climate and network effects on internal migration in South Africa revealed by a network model. *Population and Environment, 43*(3), 289–318.

https://doi.org/10.1007/s11111-021-00392-8

Zickgraf, C. (2021). Climate change, slow onset events and human mobility: Reviewing the evidence. *Current Opinion in Environmental Sustainability, 50*, 21–30.

https://doi.org/10.1016/j.cosust.2020.11.007

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods, 18*(3), 429–472.

https://doi.org/10.1177/1094428114562629

Appendix

The following table and figures support the analyses summarized in the main text.

Table A1. Analytical procedures

Analysis	Unit of analysis	Purpose
Performance analysis	Publications, authors, sources, institutions and countries	Assess publication growth, productivity, citation visibility and disciplinary distribution
Co-authorship analysis	Authors, institutions and countries	Examine collaboration networks and regional and international research relationships
Keyword co-occurrence	Author keywords	Identify the conceptual structure and principal research clusters
Co-citation analysis	Cited references and cited authors	Identify the intellectual and theoretical foundations of the field
Bibliographic coupling	Publications	Identify current research fronts sharing similar reference foundations
Citation analysis	Publications and sources	Identify influential publications and publication outlets
Overlay visualization	Keywords and publications	Examine the temporal development of concepts and research areas
Structured thematic analysis	Included publications	Analyze mobility forms, adaptation framings, governance mechanisms, justice, and knowledge leadership

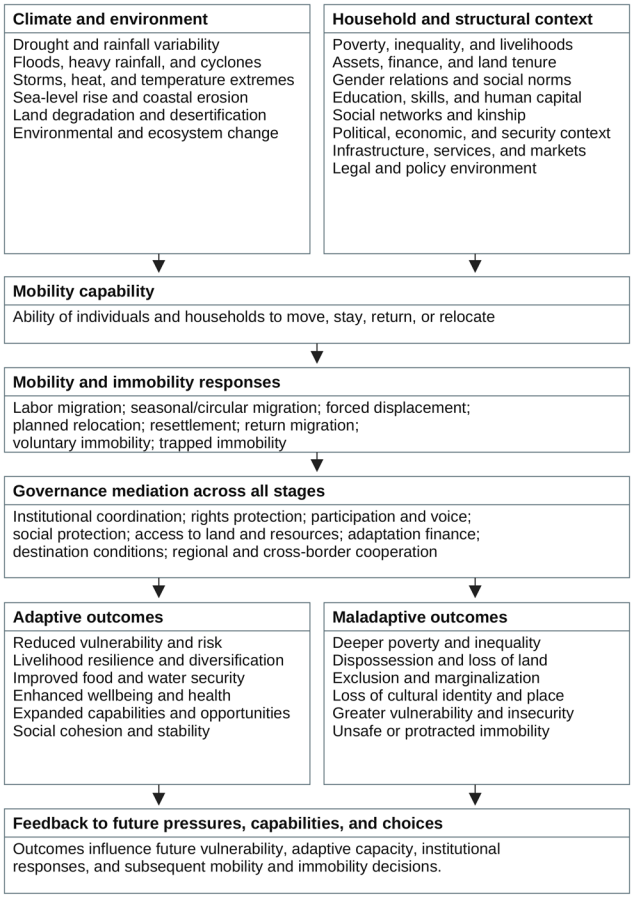

Figure A1. Governance-mediated mobility as an adaptation framework. Environmental and structural pressures shape mobility capability and responses; governance mediates their consequences, which feed back into future choices.

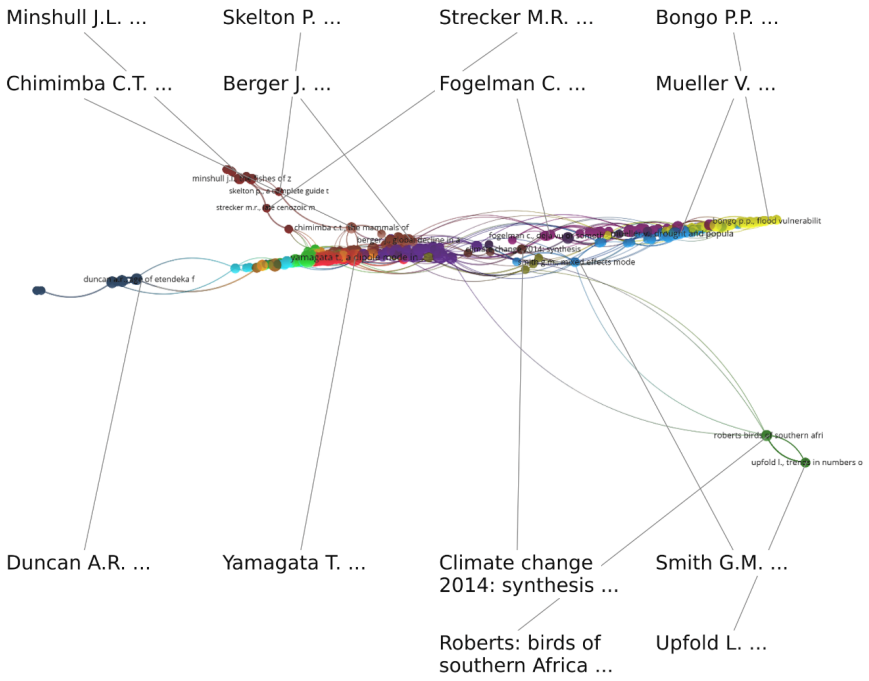

Figure A2. Co-citation network of cited references in climate-related human mobility scholarship on the Southern African Development Community region. Enlarged identifiers follow the abbreviated source labels; gray leader lines identify labels and do not denote network links.

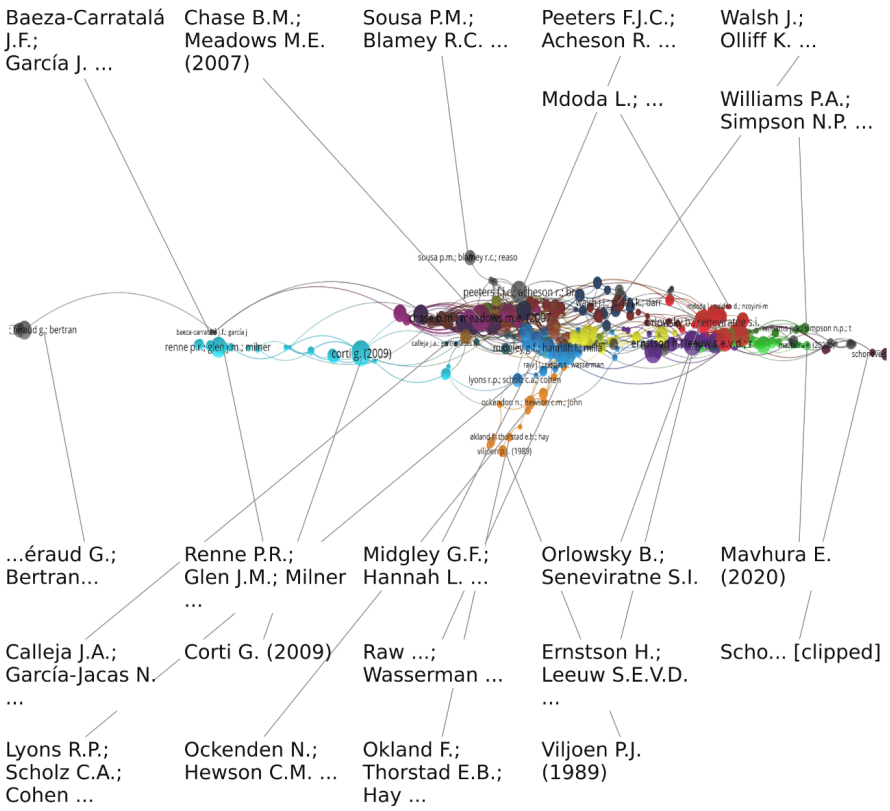

Figure A3. Bibliographic-coupling network of publications showing contemporary research fronts. Enlarged identifiers retain source abbreviations and clipping; gray leader lines identify labels and do not denote network links.

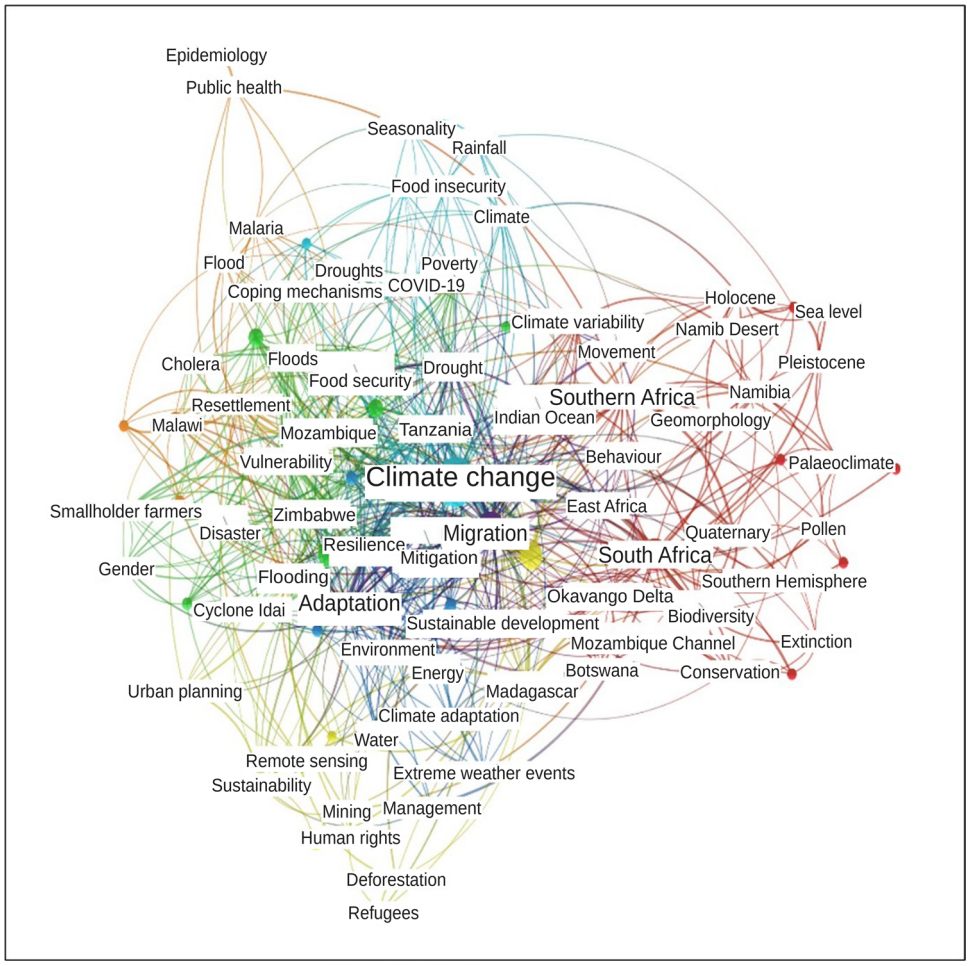

Figure A4. Keyword co-occurrence network of climate-related human mobility scholarship in the Southern African Development Community region. Grey leader lines identify displaced labels.