

## Climate Change and Migration: Research trends through a bibliometric lens

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### Abstract

Migration has been an issue for some time across many parts of the globe. But the migration induced by climate-change has been in focus by researchers lately. When it comes to climate-induced migration, the case is not just about numbers but also about the rules, border handling, resilience, post-sustenance and effect on the productivity & GDP too. Despite advancements in technology, there are limitations in prediction models which makes the situation complex. The study aims to provide insights that will guide future research and promote the sustainable growth of this rapidly developing field while also identifying gaps and unexplored areas. Therefore, this paper employed bibliometric analysis, using VOSviewer to analyze multiple scholarly items from Scopus, to comprehensively examine the research that is happening in the area of climatic refugees. Keywords were used in the Scopus database and 3957 articles meeting the inclusion and exclusion criteria were selected. Publication trend, keyword analysis, co-citation & bibliometric analysis were undertaken. By examining academic literature through citation analysis, network & density visualizations and trend assessments, this study identified significant themes and patterns in the research across countries in in the area of climate-change induced migration. The findings offer valuable information for policy makers and planners.

**Keywords:** Migration, Climate Change, refugees, bibliometric analysis

### 1 Introduction

Climate change is one of the most significant global challenges of this century with multiple dimensions of impact (environmental, economic progression and overall wellness of humans). Among all the consequences, increasing focus is coming up in the area of migration induced / influenced by climate change. Migration is happening and it will increase because of climatic effects like rising sea-levels, temperature variations and varied agricultural productivity. The migrations pose multifaceted issue with socioeconomic, political and security dimensions. No doubt research is happening by individuals and institutions alike.

Researchers predict that by 2050 the number of climate change refugees may outnumber the number of traditional refugees i.e. those defined as per the 1951 Refugee Convention and its 1967 Protocol. (Bonnie et al, 2009). The research area in this topic remains fragmented, with debates persisting over terminology (e.g., "climate refugees" versus "environmental migrants"), methodological approaches and the attribution of climate change to specific migration flows.

The concept of 'climate refugees' has been part of public discussions since 1985. It was then that Essam El-Hinnawi, an expert with the United Nations Environment Programme (UNEP), described 'environmental refugees' as follows

*“those people who have been forced to leave their traditional habitat, temporarily or permanently, because of marked environmental disruption (natural and/or triggered by people) that jeopardised their existence and/or seriously affected the quality of their life’.”* Sadly, there is no planned effort to improvise the definition to include people affected by climate change. This has been pointed out by various researchers from time to time. We have confusion because of climate change (confused between “Climate change”, “global warming”, “climate impact”, “climate hazard”) and migration (confused with “displacement”, “migration”, “relocation”, “human mobility”).

In absentia of any rule, we have to pick information from available research. It is to be noted that climatic changes are affected by the following: Geophysical (involving earthquakes, tsunamis, volcanic eruptions and landslides) and Weather-related (including flood, storms, landslides, droughts, wildfires and extreme temperatures) (Internal Displacement Monitoring Centre, 2022). Human mobility is slightly complex because of its categorization. The accepted models are: Displacement (forced to leave), Migration (predominantly voluntarily but potentially influenced by others), Planned relocation (solution-oriented measures) and Immobility (want to move but cannot).

The least developed countries and small island nations are the worst affected. Fiji, Vanuatu, Solomon Islands, Tonga, Northern Mariana Islands, Samoa, Micronesia, New Caledonia, American Samoa and French Polynesia have seen the largest exodus between 2010-2021 (World Bank, 2021).

Adaptation and resilience are the cornerstones of such exodus. We really have not done enough in terms of visualization of the problem leave alone planning to mitigate the same.

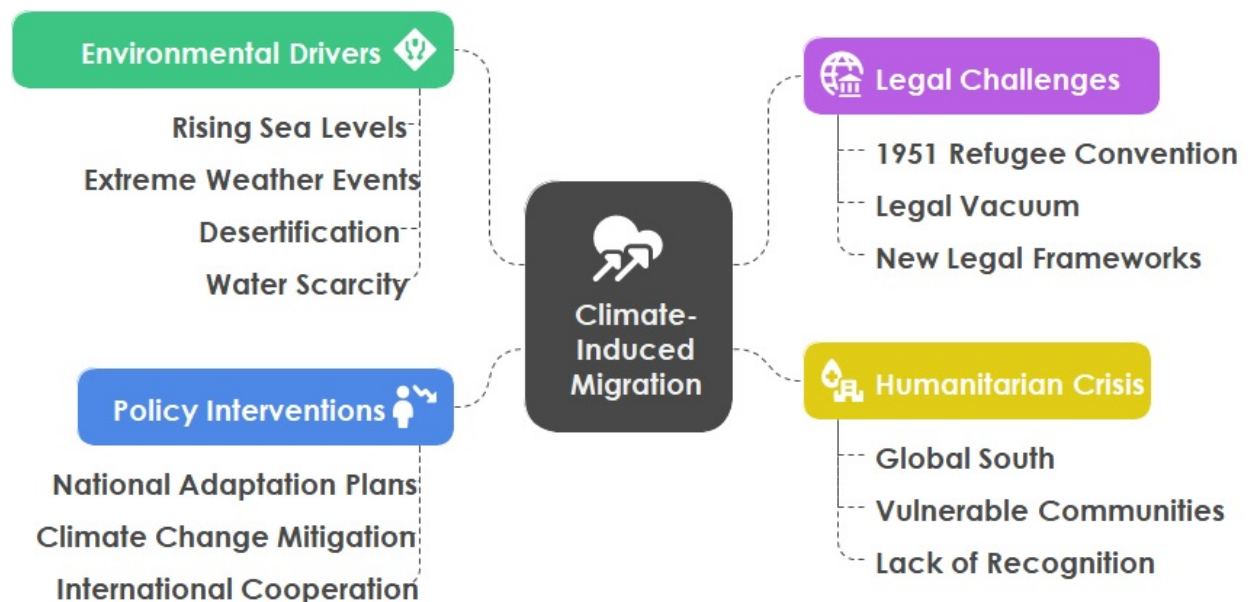


Fig 1: Challenges & Solution: Climatic Refugees

Source: Authors

### 1 Research Questions

The authors chose to address the following Research Questions (RQ)

RQ1: What has been the pattern of research publications in the research area of “Climatic Refugees” over the years?

RQ2: In what ways have countries, institutions and authors helped with research in this space?

RQ3: Which journals and articles in the Climatic Refugees field have the most significant citations?

RQ4: Based on citations, which of these research works is the most widely cited in the Climatic Refugees space?

### 2 Developments in the area of climatic refugees

<i>Sl. No.</i>	<i>Authors</i>	<i>Year</i>	<i>Description / development(s)</i>
1	Bettini, G	2014	There is a marked shift in the discourse around climate-induced migration from a focus on "climate refugees" and security threats to a more nuanced discussion of human security, resilience and adaptation. The mentioned shift is visible across policy decisions, discussion in multilateral forums and academics.
2	Milan, A et al	2014	There is a linkage between access to urban economic opportunities in shaping livelihoods and migration patterns of local communities. It was observed that there is a marked difference in livelihood and human mobility patterns depending on altitude of the place.
3	Upadhyay, H et al	2015	There is lack of empirical evidence linking climate change and migration. Infact many terminologies used in these domains are confusing at time. The researchers suggest a multi-disciplinary approach to inform policies concerning the links between climate change and migration.
4	Berchin, I et al	2017	The key reasons for climate-induced migration are: deforestation, desertification and global warming. Every migration is to be seen through multiple lens namely: economic, political and social issues.
5	Mattar, S et al	2018	The absence of a formal definition for those displaced by climate-related factors leaves many without recognition or assistance. Climate-induced migration risks infringing on their rights to development and security, increasing exposure to exploitative conditions.
6	Falco, C et al	2018	Climate change is expected to severely impact the global economy particularly the agriculture sector. Migration serves as an adaptation strategy for individuals and households to manage climate change-induced risks,

			like adverse weather. Food security is also a critical aspect to consider in discussions about climate change.
7	Sydorenko, V	2018	Researchers ought to appreciate the fact that identification and understanding of climate refugees is a direct consequence of global climate change.
8	Shi, K et al	2019	There is enough evidence to state that economic, social and political factors are potent forces that directly drive migration. In contrast, demographic and environmental factors contribute indirectly by affecting other socioeconomic determinants.
9	Cole, P	2020	There is a requirement to bring some elements of international responsibility for the environmentally displaced and it is a comprehensive issue.
10	Sengupta, S et al	2020	There is a requirement of adopting a inclusive, rights-based social policy from a scheme-based support while handling and making policy around migration. This is a key learning from the Covid measures in India.
11	Ferris, E	2020	Climate change induced migration is a field in which research of multiple types are happening and referred to as "field in formation" or one with "a hundred flowers blooming". The key five areas of research in the field are: climate change scientists, migration researches, disaster reduction, development actors and international law.
12	Kakinuma et al	2020	Floods are a significant cause of population migration across the globe. There was also significant proof to state that income level significantly impacted flood-induced displacement with lower income levels amplifying displacement. While high-income countries generally had lower flood-induced migrations, some like Japan, Australia and France came out as exceptions. It was also clear that economic development and local adaptation were equally crucial for enhancing resilience to floods.
13	McEldowney et al	2021	Individuals affected by climate-change are currently not covered under any existing treaties, leading to challenges in providing legal protections for those displaced due to climate change.
14	Sarker S et al	2021	Bangladesh is a country with substantial figures on migration. Upon analysis, it was observed that the primary causes of migration and displacement identified were extreme climatic events, including

			riverbank erosion, cyclones, storm surges, floods and salinity intrusion. The findings forms the base for many policies at the international level.
15	Swayamprakash, A et al	2021	Climate-induced migration will be a major issue by 2050 as the affected population may touch 200 Million. There is a need to broaden the definition and ambit of climate change.
16	Conte, B	2022	Climate change will have significant impacts on migration in Sub-Saharan Africa. The effects however can be mitigated through appropriate policy interventions. Reducing migration barriers and trade frictions can help the region adapt more efficiently to climate change, reducing welfare losses and promoting more equitable outcomes. It is suggested that migration and trade policies must be simultaneously tackled if the problem of climate-change needs to be addressed.
17	Dasgupta, S et al	2022	Effective public management w.r.t. climate change requires a deep understanding of the affected cohorts, the ability to anticipate how these communities may react as climate impacts intensifies and lastly the implementation of cost-effective adaptation policies. For policymakers to make sound decisions, it is essential that they rely on solid evidence drawn from actual country experiences, ensuring that adaptation strategies are both practical and informed by real-world outcomes.
18	De Moor, J	2022	Activists who support an equal focus on adaptation and mitigation tend to feel less hopeful about the effectiveness of climate policies and are less likely to support far-reaching, transformative climate action, reflecting more conservative attitudes within the movement.
19	Fransen et al.	2022	Many refugee settlements, especially in Africa and South Asia are critically exposed to extreme weather—particularly rising temperatures and reduced rainfall. These camps are often located in environmentally vulnerable, remote areas with poor infrastructure, worsening the impact of climate stress. While rapid-onset events like storms vary, the ongoing environmental conditions pose serious risks to refugees' health, safety and livelihoods. The authors call for inclusive climate adaptation strategies that

			integrate both refugees and host communities to build long-term resilience.
20	Nabong et al	2023	Mitigation and intervention plans aimed towards climate-induced migration must consider the following factors: financial, livelihood planning of the affected cohorts and food-security for ensuring better results and predictability.
21	Yue, S et al	2023	Higher temperatures increase migration “intentions” especially among those with lower education levels, females and rural residents. This indicates the need for policy framers to address the differential impacts of climate change and support underprivileged groups to enhance their adaptive capacity.
22	Liang, B et al	2023	Good areas of future research in the study of climatic change can happen in the following areas namely: different types of climate migration, quantitative models for climate migration and climate justice. Climate change induced migration is an area which is interdisciplinary in nature and thus there is a requirement of collaboration from experts and researchers from multiple domains. China can be a research ground for many researchers because of its experience in resettlement of people affected by this kind of migration.
23	Narayanan, B K et al	2023	The researchers advocate strongly assigning a special "climate refugee/migrant" status to ensure human rights protections for the people affected by climate change. There should be a creation of “loss and damage” fund for developing countries.
24	Nasrin, N et al	2023	Climate change is emerging as a major reason for human migration as a whole across the globe. It is observed that academic research is happening in countries which are not affected by climate-change induced migration.
25	Zvarych, I et al	2023	There has been a drastic increase in people being affected by climate change and forced to go for migration. A vast majority (atleast 90 percent) are from the low-income countries or small island nations.
26	Chandra et al	2023	Climate change-induced mass migration poses a major challenge to the prevalent public health systems, which are often unprepared to meet the needs of displaced

			populations. The researchers argue that the quantum of migration driven by environmental stress can strain already fragile health infrastructures, particularly in low-resource settings.
27	Almulhim, A et al	2024	<p>There is a clear need for targeted adaptation strategies and international support to manage climate-induced migration in Global-South effectively.</p> <p>Increasing temperatures are positively associated with migration. For example, a 1°C temperature increase leads to a 1.9% increase in global migration.</p> <p>Water stress and drought are significant push factors behind migration and floods &amp; sea-level rise are major reasons behind migration in coastal populations.</p> <p>There is a need for adaptation strategies that consider the differential impacts of climate-induced stressors on various socio-demographic groups. Support from Global North countries, including compensation for losses and damages, along with continued institutional and financial support from international non-governmental organizations, is crucial for managing climate-induced migration in the Global South.</p>
28	Daoust, G	2024	Climate change effects on migration can be evaluated through various lens like: short-term shocks, environmental factors, long-term climatic themes, narratives and perceptions.
29	Koci, J et al	2024	There is insufficiency of international laws to protect people being forced to migrate because of climatic changes. The 1951 Refugee Convention covers persecution but does not mention migration due to environmental harm.
30	Schewel, K et al	2024	<p>Current forecasting models which are being used by Institutions to predict migration are unable to provide reliable numerical estimates for future climate-related migration. Instead, models serve more effectively as tools for exploring a range of futures, testing theories, and evaluating potential policy effects.</p> <p>There is a critical need for better migration data collection. Enhanced interdisciplinary and multi-disciplinary collaboration is essential for improving the accuracy of predicting models. Scenario-based planning is recommended for development planners and policymakers to prepare for climate-related mobility.</p>

31	Waidelich, P et al	2024	The magnitude of temperature increment coupled with precipitation, temperature variability and extreme events will have devastating effect on the GDP of nations. There is a need for region specific risk-assessment as the characteristics of all places would be different.
32	Favretto, N et al	2024	Climate / environment induced migration is one of the shared impacts felt across vulnerable geographies such as highlands, coastal belts, drylands and islands. There is documented proof that these areas are experiencing livelihood failure, food insecurity, degradation of human health and economic sector losses, leading to human migration and associated conflicts.
33	Fransen, S et al	2024	There is a need for sustainable and durable solutions that focus on integration, resettlement, or return, in line with the “Global Compact on Refugees”. Displaced populations are highly exposed to climate hazards, with significant impacts on their health, property and psychological well-being.
34	Draper, J et al	2024	One ought to have a pluralist approach when it comes to addressing climate-related immigration. It is an area which demands that existing legal and political frameworks requires a complete overhaul. There is a need for integrating integrating ethical, legal and political aspects to ensure more inclusive, effective protection for those displaced by climate change.
35	Hoffman, R et al	2024	Increased drought and aridity significantly impact internal migration patterns, particularly in hyper-arid and arid regions. Migration is influenced by the socioeconomic characteristics of both origin and destination areas, such as wealth, agricultural dependency, and urbanization. The influence of climate on migration is stronger in wealthier countries.
36	Naz, S et al	2024	It is seen that affected individuals (of migration) resort to seasonal and temporary migration as a strategy to cope with gradual climate impacts like rising temperatures and salinity. In contrast, permanent migration is often necessitated by severe events such as cyclones and river erosion. The role of social networks is significant, influencing migration decisions through shared information from urban and rural connections.

37	Ghose et al	2024	Climate change-induced catastrophes, which negatively impact physical and mental health, are expected to increase human migration. People have developed specific resilience mechanisms which they employ to cope with the psychological effects of displacement. It is also to be noted that there are deficiencies in the existing legal structures for climate refugees.
38	Siqueira, V et al	2024	There is lack of legal clarity with respect to climatic migration. The situation is slightly more complex in South. Addressing climate-induced displacement requires integrating environmental law, human rights and migration policy, with a keen focus on equity and justice. As per international conventions, refugee law (especially the 1951 Refugee Convention) only protects individuals fleeing persecution based on race, religion, nationality, political opinion or membership in a particular social group. It does not cover people displaced by environmental changes or climate-related events.
39	Cheng, Y et al	2024	It is worthwhile to note that the prevalent norms and international laws are insufficient to address the unique challenges faced by individuals displaced due to climate change. The researchers propose a new legal mechanism that integrates principles from human rights law, refugee law and environmental law to provide adequate protection and support for climate refugees. The researchers emphasize the importance of international cooperation and the development of specific legal instruments to ensure the rights and well-being of those affected by climate-induced displacement.
40	Chetto, R et al	2024	Responses to challenges like droughts or pests depend on households' adaptive capacity. Nations while strengthening their respective climate policy frameworks should include climate change-induced migration into their adaptation plans.
41	Schriever, S	2024	Climate migration is traditionally situated beyond International organisation of Migration's mandate; however, the organisation was present in the institutional process through which the adaptation framing emerged and now carries out operational projects related to the topic.

42	Tsui, J et al	2024	<p>Studies have found out that migration because of climate-change has the potential to undo the benefits &amp; progress made in controlling pandemic diseases.</p> <p>Migration can lead to the entry of pathogens (of diseases) into regions where these diseases did not have a history. As people move due to climate change, they may end up in overcrowded informal settlements, increasing the risk of disease spread.</p>
43	Woodworth, F	2024	<p>Global North countries have conveniently excluded climate migration and have generally avoided obligations to climate migrants. This approach is influenced by the rise of populist nationalism, which promotes national interests over global responsibilities and advocates for stricter immigration controls. Additionally, the securitisation of migration has led to more restrictive policies focused on border control, making it difficult for climate migrants to seek refuge. The complexity of the causal relationship between climate change and migration, which often involves multiple factors, further complicates the establishment of clear legal frameworks and obligations for climate migrants.</p>
44	Ucler et al	2025	<p>There has to be a consensus for the improvement of international awareness and shared responsibility towards individuals (and communities) displaced or migrating due to the adverse effects of climate change. There is a requirement of clarity in definition, scope and legal status of climatic refugees.</p>
45	Rajshree, M et al	2025	<p>There is an urgent need for a more robust and inclusive legal framework to protect those increasingly displaced by the effects of climate change. The numbers are going to increase as there is no respite in the increasing effects of climate-change.</p>
46	Rao, M. Rajeshwar	2025	<p>Communications regarding Climate-change should emphasize collective efficacy and inclusive norms to mitigate these adverse effects. Future research should further explore the mechanisms and boundary conditions of these effects. Climate change as per the researchers is not just an environmental issue but also a social and psychological one. It can exacerbate conflicts by depleting natural resources and causing mass migration.</p>

### **3 Methodology & Data**

Scopus, published by Elsevier Co., is a database for abstracts and indexing that includes links to full-text articles. Scopus database has emerged to be a reliable database for research. The collation is in the form of conference publications, academic articles, review articles, books, book reviews, editorials, book chapters and book series (Guz, A N and Rushchitsky, J J, 2009).

VOSviewer is a popular bibliometric tool frequently utilized to construct bibliometric networks involving various entities, such as authors and organizations. It employs diverse network analysis techniques, including co-authorship, co-citation, term co-occurrence, and bibliographic coupling (Van Eck & Waltman, 2009).

VOSviewer is a software program used to create network visualizations based on frequently used terms within a specific field. Highly favored in bibliometric analysis, it effectively highlights influential authors by placing them centrally in a visual map, while less influential authors are positioned on the periphery, clearly distinguishing their impact. Furthermore, VOSviewer provides a more precise and insightful data representation than other mapping methods. (Van Eck, Nees Jan and Waltman, Ludo, 2009).

The development of research that eventually gave rise to the specialized area of bibliometrics is traced from its origins up to 1969 when the term "bibliometrics" was first introduced as an alternative to "statistical bibliography." (Broadus, Robert, 1987). Allan Pritchard first introduced the term "Bibliometrics" in 1968, but it gained greater popularity during the 1980s. He defined the term as a novel discipline that employed quantitative methods to examine scientific communication by quantifying and analyzing various facets of written works.

Nicholas and Ritchie (1978), in their book entitled "Literature and Bibliometrics", stated that bibliometrics "...provide information about the structure of Knowledge and how it is communicated...". Sengupta (1990) defined this term as the "organization, classification and quantitative evolution of publication patterns of all macro and micro communications along their authorship by mathematical and statistical calculus".

The increasing volume of publications presents challenges in analyzing these studies through traditional methods (Olson, David and Delen, Dursun (2008)). For example, identifying the research topics favored by authors and understanding how trends in these areas have evolved can be complicated. The significant increase in data and publications on each topic has led to exploring newer methods for managing it. In this regard, some researchers have started using systematic reviews and bibliometric analysis to identify trends and research topics within a particular field (Nie, Binling and Sun, Shouqian (2016)). A core element of bibliometric analysis involves evaluating the connections between different bibliometric components, such as journals, documents, authors, or keywords. These relatedness measures are employed for various purposes, including creating maps or visual representations that illustrate the connections among all items within the dataset (Klavans, Richard and Boyack, Kevin (2004)).

#### **3.1 Need for the study**

We found few papers on the bibliometric analysis of climatic refugees. The problems associated with climatic refugees is increasing in terms of climatic reasons, possible economic impacts and failure in design of the perfect predictive model for the same. Besides, there is absence of international rules around the topic. Hence, there is a growing number of research papers and publications; thus, the necessity of synthesis of them.

Future researchers (new to this area and wanting to improve further) can take the help of this paper to find the best journals, articles and authors. It can help them immensely. Authors and researchers specializing in structured literature review formats can take note of the cited articles. Besides, researchers may plan to link this topic with other disciplines like economics, innovation, governance, legalities, et al.

There is also need for the study because of the importance of it. Some of the distinct issues involved with climate migration are: change in demography of the new adopted place, possibility of increment of cross-border tensions when migration crosses borders, possibility of environmental stress because of over-population in the newly adopted area, et al. Besides, it throws some questions to the planners as to the possibility of regional cooperation to tackle the problem together. Can we also think of EWS for planned relocation.

### 3.2 Dataset

For the work, the Scopus database was searched on 30-Jun-2025. The steps involved in choosing the set of articles for review are as follows

		<i>Include</i>	<i>Exclude</i>	<i>Net</i>
Step 1	Scopus search using the following keywords: ( climat* change induced migration ) or ( environment* change induced migration ) or ( climat* migrant* ) or ( environment* and migrant* ) or ( climat* refugee* ) or ( environment* refugee* ) or ( global warming induced migration )	24952		24952
Step 2	Filter & limit to Publication years from 2020 to 2025	10983		10983
Step 3	Filter & limit "Document type" to "Article", "Book" and "Book Chapter"	9644		9644
Step 4	Filter & limit to "Final" in "Publication Stage"	9356		9356
Step 5	Filter & limit to "English" in "Language"	8793		8793
Step 6	Filter & limit to subject areas being "Social Sciences", "Environmental Science", "Economics, Econometrics & Finance" and "Business, Management & Accounting"	5750		5750
Step 7	Filter and exclude articles with the following keywords: European Union (45), Jordan (47), Africa (47), Turkey (51), Canada (59), Italy (62), Europe (81), Australia (84), Migrant Bird (89), Middle Aged (92), Birds (99), United Kingdom (103), Bird (117), Child (140), Bangladesh (147), Covid-19 (149), Non Humans (173), Animal (193), Animals (196), United States (235), Adult (334), China (357), Male (365) and Female (420)	4005	1745	4005
Step 8	Filter and exclude articles with the following source types: Trade Journal (2)		2	4003

Step 9	Filter and manually exclude article(s) with missing authors		11	3992
Step 10	Filter and manually exclude article(s) with missing / improper abstracts		35	3957

The copy of the exact query is as follows: (TITLE-ABS-KEY(( climat\* change induced migration ) or ( environment\* change induced migration ) or ( climat\* migrant\* ) or ( environment\* and migrant\* ) or ( climat\* refugee\* ) or ( environment\* refugee\* ) or ( global warming induced migration )) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND ( LIMIT-TO ( DOCTYPE,"ar" ) OR LIMIT-TO ( DOCTYPE,"ch" ) OR LIMIT-TO ( DOCTYPE,"bk" ) ) AND ( LIMIT-TO ( PUBSTAGE,"final" ) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) ) AND ( LIMIT-TO ( SUBJAREA,"SOCI" ) OR LIMIT-TO ( SUBJAREA,"ENVI" ) OR LIMIT-TO ( SUBJAREA,"BUSI" ) OR LIMIT-TO ( SUBJAREA,"ECON" ) ) AND ( EXCLUDE ( EXACTKEYWORD,"Female" ) OR EXCLUDE ( EXACTKEYWORD,"Male" ) OR EXCLUDE ( EXACTKEYWORD,"Adult" ) OR EXCLUDE ( EXACTKEYWORD,"China" ) OR EXCLUDE ( EXACTKEYWORD,"United States" ) OR EXCLUDE ( EXACTKEYWORD,"Animals" ) OR EXCLUDE ( EXACTKEYWORD,"Animal" ) OR EXCLUDE ( EXACTKEYWORD,"Nonhuman" ) OR EXCLUDE ( EXACTKEYWORD,"Covid-19" ) OR EXCLUDE ( EXACTKEYWORD,"Bangladesh" ) OR EXCLUDE ( EXACTKEYWORD,"Child" ) OR EXCLUDE ( EXACTKEYWORD,"Bird" ) OR EXCLUDE ( EXACTKEYWORD,"United Kingdom" ) OR EXCLUDE ( EXACTKEYWORD,"Birds" ) OR EXCLUDE ( EXACTKEYWORD,"Middle Aged" ) OR EXCLUDE ( EXACTKEYWORD,"Migrant Bird" ) OR EXCLUDE ( EXACTKEYWORD,"Australia" ) OR EXCLUDE ( EXACTKEYWORD,"Europe" ) OR EXCLUDE ( EXACTKEYWORD,"Italy" ) OR EXCLUDE ( EXACTKEYWORD,"Canada" ) OR EXCLUDE ( EXACTKEYWORD,"Turkey" ) OR EXCLUDE ( EXACTKEYWORD,"Jordan" ) OR EXCLUDE ( EXACTKEYWORD,"Africa" ) OR EXCLUDE ( EXACTKEYWORD,"European Union" ) ) AND ( EXCLUDE ( SRCTYPE,"d" ) ) )

All the analysis in this paper would be basis these 3957 research items. A small analysis of the concerned documents are as follows

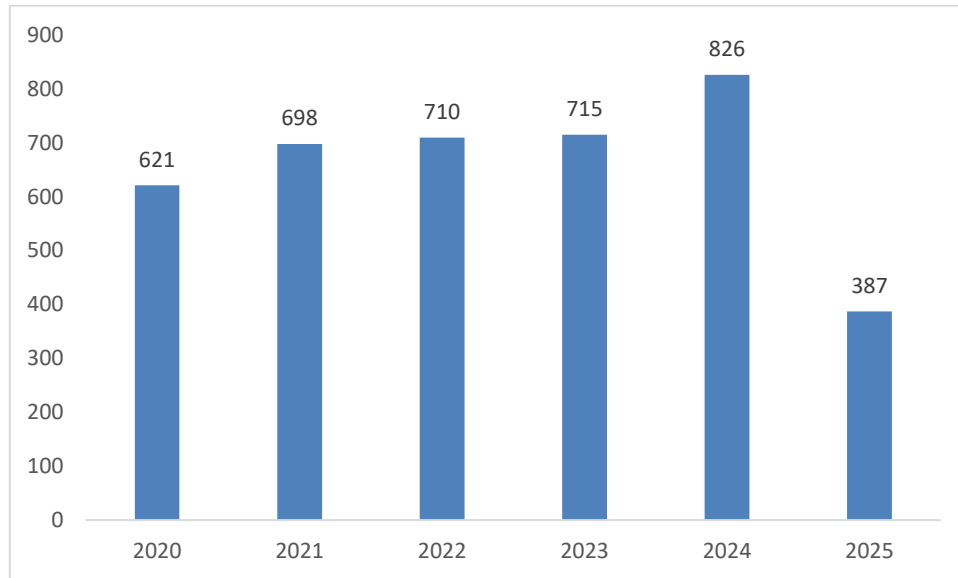
<i>Description</i>	<i>Data</i>	<i>Description</i>	<i>Data</i>
<b>Time Span</b>	2020-2025	<b>Per Document Avg. Citation</b>	5.52
<b>Articles</b>	2882	<b>Per Document Avg. Citation / year</b>	1.10
<b>Books</b>	825	<b>Author Keywords</b>	11035
<b>Book Chapters</b>	250	<b>Index Keywords</b>	5732
<b>Citations</b>	21854	<b>Authors</b>	10488

Table 1: Summary of document types covered for the bibliometric analysis

Source: Collated by authors basis data from Scopus

## 4 Analysis and interpretations based on data from Scopus and VosViewer

### 4.1 Publications trends



*Fig 2: Publication over the years*

*Source: Compiled by authors based on data from Scopus*

It is clearly observed that there has been a distinct trend in the improvement of a number of articles being published in the space of Climatic Refugees. This can be attributed to the fact that climate change is being recognized across the globe as an important element and hence the researches in this space.

### 4.2 Basis article publications

The details of journals with the maximum published articles on Climatic Refugees are as follows

<b>Journal Name</b>	<b># articles</b>	<b>ISSN</b>	<b>Publisher</b>
Sustainability (Switzerland)	52	2071-1050	Multidisciplinary Digital Publishing Institute (MDPI)
Social Sciences	33	2076-0760	Multidisciplinary Digital Publishing Institute (MDPI)
Ecology and Evolution	30	2045-7758	John Wiley and Sons Ltd
IMISCOE Research Series	27	2364-4087	Springer Science and Business Media B.V.
Journal of Ethnic and Migration Studies	24	1369-183X	Routledge
Frontiers in Ecology and Evolution	22	2296-701X	Frontiers Media SA
Journal of Refugee Studies	19	0951-6328	Oxford University Press

Frontiers in Marine Science	18	2296-7745	Frontiers Media S.A.
International Journal of Disaster Risk Reduction	18	2212-4209	Elsevier Ltd
Land	17	2073-445X	Multidisciplinary Digital Publishing Institute (MDPI)

Table 2: Best journals in terms of articles published on Climatic Refugees

Source: Authors basis data from Scopus

The journals have been stacked in descending order of number of publications on the subject of Climatic refugees. Sustainability (Switzerland) has the largest number of papers.

#### 4.3 Publication basis countries

<i>Country</i>	<i># articles</i>
United States	829
United Kingdom	521
Germany	258
India	245
China	221
Australia	215
Canada	190
Netherlands	170
Italy	148
Spain	136

Table 3: Country-wise publications

Source: Authors basis data from Scopus

The countries have been stacked in descending order of papers published on the theme of Climatic Refugees. Research is happening substantially across developed and developing countries.

#### 4.4 Basis journal citations

<i>Journal Name</i>	<i># citations</i>	<i>ISSN</i>	<i>Publisher</i>
Sustainability (Switzerland)	565	2071-1050	Multidisciplinary Digital Publishing Institute (MDPI)
Journal of Cleaner Production	365	0959-6526	Elsevier Ltd
Journal of Ethnic and Migration Studies	346	1369-183X	Routledge
Frontiers in Ecology and Evolution	247	2296-701X	Frontiers Media SA
Energy	239	0360-5442	Elsevier Ltd

Nature Climate Change	238	1758-678X	Nature Research
Water Research	230	0043-1354	Elsevier Ltd
World Development	220	0305-750X	Elsevier Ltd
Ecology and Evolution	203	2045-7758	John Wiley and Sons Ltd
Frontiers in Marine Science	199	2296-7745	Frontiers Media S.A.

Table 4: Best journals in terms of citations on articles on Climatic refugees

Source: Authors basis data from Scopus

“Sustainability (Switzerland)”, “Journal of Ethnic and Migration Studies”, “Frontiers in Ecology and Evolution”, “Ecology and Evolution and “Frontiers in Marine Science” are the most important journals in this space as they have they the largest number of articles as well as citations (of those articles). “Sustainability (Switzerland)” is the only journal which has citations of more than 500.

#### 4.5 Basis Article Citations

Title	Authors	Cited by	Year	Journal Name	ISSN
How energy consumption, industrial growth, urbanization, and CO2 emissions affect economic growth in Pakistan? A novel dynamic ARDL simulations approach	Abbasi, Kashif Raza; Shahbaz, Muhammad; Jiao, Zhilun; Tufail, Muhammad	239	2021	Energy	0360-5442
Ultraviolet-C and vacuum ultraviolet inducing surface degradation of microplastics	Lin, Jialing; Yan, Deyi; Fu, Jianwei; Chen, Yuheng; Ou, Huase	230	2020	Water Research	0043-1354
Temperature-related biodiversity change across temperate marine and terrestrial systems	Antão, Laura H.; Bates, Amanda E.; Blowes, Shane A.; Waldoock, Conor; Supp, Sarah R.; Magurran, Anne E.; Dornelas, Maria; Schipper, Aafke M.	199	2020	Nature Ecology and Evolution	2397-334X
A Picture Paints a Thousand Lies? The Effects and Mechanisms of Multimodal Disinformation and Rebuttals Disseminated via Social Media	Hameleers, Michael; Powell, Thomas E.; Van Der Meer, Toni G.L.A.; Bos, Lieke	172	2020	Political Communication	1058-4609

Quantifying the Carbon Export and Sequestration Pathways of the Ocean's Biological Carbon Pump	Nowicki, Michael; DeVries, Tim; Siegel, David A.	148	2022	Global Biogeochemical Cycles	0886-6236
Social Policy, COVID-19 and Impoverished Migrants: Challenges and Prospects in Locked Down India	Sengupta, Sohini; Jha, Manish K.	125	2020	International Journal of Community and Social Development	2516-6026
Against climate apartheid: Confronting the persistent legacies of expendability for climate justice	L Rice, Jennifer; Long, Joshua; Levenda, Anthony	94	2022	Environment and Planning E: Nature and Space	2514-8486
'A really hostile environment': Adiaphorization, global policing and the crimmigration control system	Bowling, Ben; Westenra, Sophie	93	2020	Theoretical Criminology	1362-4806
Indie Unions, Organizing and Labour Renewal: Learning from Precarious Migrant Workers	Però, Davide	86	2020	Work, Employment and Society	0950-0170
Racial capitalism, climate justice, and climate displacement	Gonzalez, Carmen G.	85	2021	Onati Socio-Legal Series	2079-5971

Table 5: Best articles in terms of citations on articles on Climatic Refugees

Source: Authors basis data from Scopus

The articles have been selected basis number of citations of each. They have been sorted in decreasing order of number of citations. We have 6 articles with each having atleast 100 citations. We observe that the article titled “How energy consumption, industrial growth, urbanization, and CO2 emissions affect economic growth in Pakistan? A novel dynamic ARDL simulations approach” has the largest number of citations.

#### 4.6 Basis Productive Co-Authors

The details with respect to the best productive authors are as follows

<b>Authors</b>	<b># Articles</b>
Van Praag L.; Ou-Salah L.; Hut E.; Zickgraf C.	4
Junker K.W.; Münster S.; Shinde M.	3
Wu X.; Wang L.	3
Asis E.; Carandang R.R.	2

Banerjee M.; Shanthakumar S.	2
Clark S.G.; Andrews E.J.; Lambert A.E.	2
Hedditch S.; Vyas D.	2
Jennath A.; Paul S.	2
Mugadza H.T.; Tetteh V.W.; Stout B.; Renzaho A.M.N.	2
Ou-Salah L.; Van Praag L.	2
Sicilianos L.-A.; Gkagkatsi A.	2
Walelign S.Z.; Cutter S.L.; Lujala P.	2

Table 6: Productive authors basis number of articles on Climatic Refugees

Source: Authors basis data from Scopus

These authors have made the maximum papers in collaboration.

#### 4.7 Basis Productive Authors

The details of paper publications basis authors are as follows

Author Name	Count		
Liu Y.	8	Zhang Y.	6
Li J.	8	Li J.	6
Wang Y.	8	Yang Y.	6
Van Praag L.	8	Van Praag L.	6
Li X.	8	Zickgraf C.	6
Zhang X.	7	Hut E.	5
Li Y.	7	Liu C.	5
Zhang J.	6	Li Y.	5
Wang Y.	6	Wang L.	5
Liu J.	6	Huang Y.	5
Zhang H.	6	Li H.	5
		Paul S.	5

Table 7: Productive authors basis number of articles on Climatic Refugees

Source: Authors basis data from Scopus

These authors were chosen based on their co-authorship. Each of them are either present as the first or are present in any other order in the list of authorship in papers.

#### 4.8 Country coupled bibliometric analysis

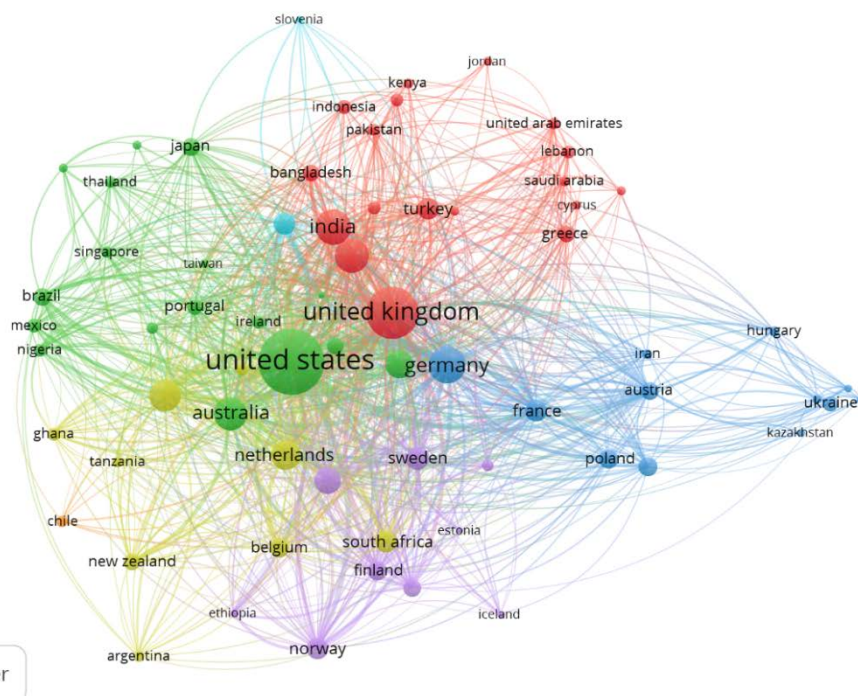
We used the minimum number of documents for a country as 10 and arrived at 68 countries. The screenshot of Vosviewer result is appended below.

Countries	Documents	Citations	Total link strength	Citations per document
United States	821	5654	88339	6.89
United Kingdom	513	3328	74533	6.49
Germany	257	2147	44469	8.35
Australia	214	1218	32350	5.69

Netherlands	169	1645	31942	9.73
Canada	186	1356	28958	7.29
France	92	634	20093	6.89
China	221	2287	18753	10.35
Switzerland	86	758	18516	8.81
Italy	147	650	18192	4.42

*Table 8: Country couple data basis total link strength*  
*Source: Vosviewer results basis data from Scopus*

The countries have been sorted basis the total link strength. China and Netherlands have the highest average citations per article. United States and United Kingdom have large number of articles but their citations strength is low in comparison to all other countries in Table 8.



*Fig 3: Country couple data basis total link strength*  
*Source: Vosviewer basis data from Scopus*

#### 4.9 Co-occurrence of author keywords

We used the minimum number of co-occurrence of author keywords as 10, and we arrived at 148 keywords out of 11035, which meet the threshold. The screenshot of Vosviewer result is appended below.

<b>Keyword</b>	<b>Occurrences</b>	<b>Total link strength</b>
migration	479	653
climate change	399	609
refugees	232	354

displacement	70	162
adaption	59	121
refugee	76	116
migrants	95	108
gender	46	106
integration	55	93
resilience	47	83
human rights	39	73
vulnerability	36	73

Table 9: Author keywords basis total strength  
 Source: Vosviewer results basis data from Scopus

“migration” and “climate change” have the highest link strengths. Most of the terms are in lines with the searches used as per the methodology defined for this paper. We see that “resilience” and “vulnerability” are also coming it signifying that these are key areas linked to climate change.

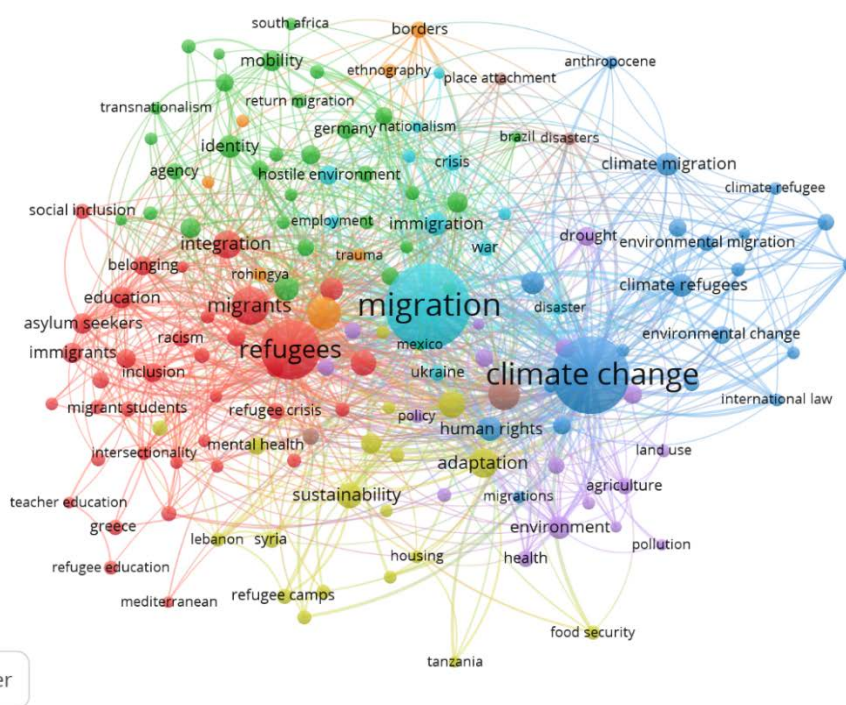


Fig 4: Author keywords basis total strength  
 Source: Vosviewer basis data from Scopus

We can see that “migration” literally overshadows every other keyword.

#### 4.10 Co-occurrence of index keywords

We used the minimum number of co-occurrence of index keywords as 20, and we arrived at 44 keywords out of 5732, which meet the threshold. The screenshot of Vosviewer result is appended below.

<i>Keyword</i>	<i>Occurrences</i>	<i>Total link strength</i>
climate change	212	362
human	90	313
article	90	303
refugee	161	294
migration	138	275
humans	45	164
immigrant	58	146
migrant	34	121
livelihood	46	109
controlled study	31	99

Table 10: Index keywords basis total strength  
 Source: Vosviewer results basis data from Scopus

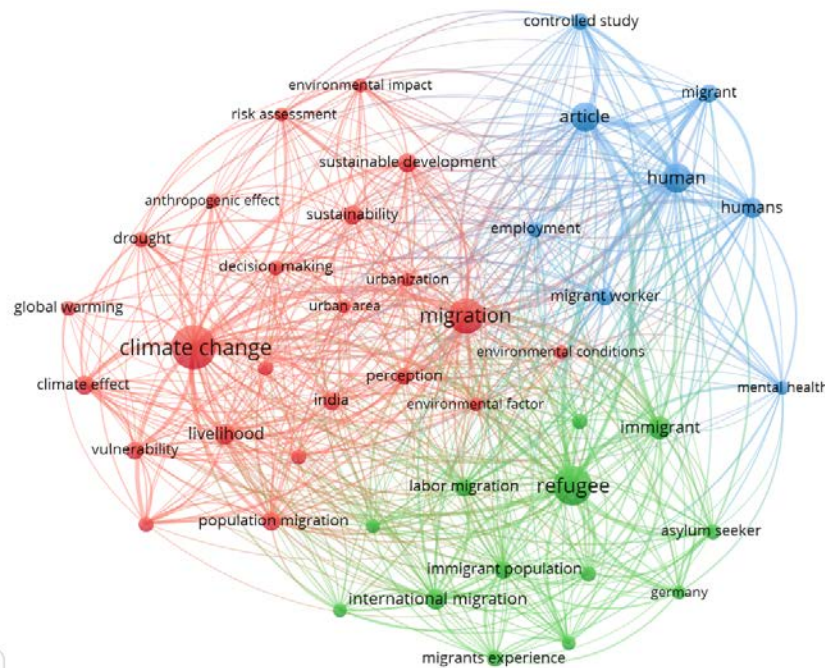


Fig 5: Index keywords basis total strength  
 Source: Vosviewer basis data from Scopus

Here, we also see that “climate change” and “human”. It is clear that the linked areas of study are livelihood and immigrants; probably these are emerging areas of research in conjunction with climatic refugees.

It is clear from the keyword (author and index) analysis and observation that the keywords used in the bibliometric search by the authors are in line with that of the ongoing research.

#### 4.11 Co-authorship Countries Analysis

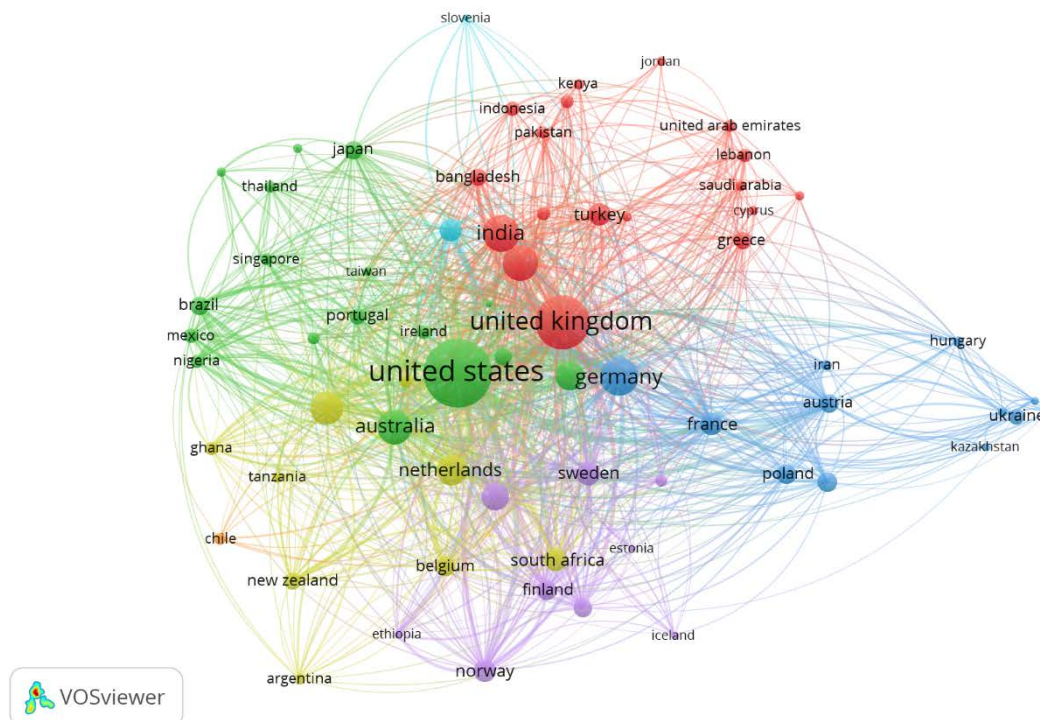
We used the minimum number of documents of a country as 10 and the minimum number of citations of a country as 5. Accordingly, we obtained 68 countries out of a total of 185 countries. The country-wise analysis basis strengths and the screenshot of Vosviewer result is appended below.

<b>Countries</b>	<b>Documents</b>	<b>Citations</b>	<b>Total link strength</b>
India	434	4654	106
United States	209	6146	104
United Kingdom	133	4048	76
Saudi Arabia	86	2789	62
China	148	1656	58
Malaysia	60	804	44
Italy	66	3149	39
Australia	56	3119	34
Germany	60	2593	34
France	42	3025	33

*Table 11: Country wise co-authorship analysis*

*Source: Vosviewer results basis data from Scopus*

The countries have been sorted in the descending order of total link strengths.



*Fig 6: Co-authorship-countries analysis*

*Source: Vosviewer basis data from Scopus*

India clearly overshadows other countries as is evident from the image. This is possibly because of the large number of papers and the second best being much lower.

#### 4.12 Funding

A total of 1556 projects have been funded by 1524 funding agencies. The large funding agencies are as follows:

<i>Funding Agency</i>	<i># projects</i>
Bundesministerium für Bildung und Forschung (Germany)	4
Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, CAPES (Brazil)	4
Social Sciences and Humanities Research Council of Canada, SSHRC (Canada)	4
Australian Government	3

*Table 12: Top funding agencies*

*Source: Authors basis data from Scopus*

Besides the ones mentioned, we have 21 agencies with at least 2 papers funded. Basis the experience of the authors in handling bibliometric studies, one thing comes out clearly i.e. this topic has funding from Government and World bodies unlike other topics. This goes on to show that this is an important aspect for multilateral and plurilateral policy makers too.

#### 5 Limitations of the Research

The research outcome is highly dependent on the papers selected and acquired from the Scopus database. It is possible that certain pertinent publications, particularly those in non-indexed or specialized journals, were not included in the analysis, thereby increasing the chances of missing out on some good & critical research papers of some serious researchers.

Although the search terms employed in the study are comprehensive and encompass several expressions relating to “Climatic Refugees”, it is important to acknowledge that researchers and academicians may have used alternate terminologies to indicate or represent the idea.

Limiting the search to only journal articles, books, and book series may lead to overlooking important insights in other publication formats, such as conference proceedings or reports.

The study exclusively examined the articles published in English; hence, it is possible to have missed a few good articles in other languages.

We have taken articles, books and book chapters from 2020 to 2025; the research done in this paper excludes the previous research documents.

While bibliometric analysis provides a systematic approach for evaluating research output and impact, it falls short of fully capturing the qualitative influence of these research. For a simple explanation as an example, citation counts measure acceptance and popularity but may not accurately convey how research findings are utilized in practical settings like mentoring or policymaking by planners. This approach might only reflect academic interests rather than the significance of the research in addressing real-world problems.

It is useful to mention here that research is inherently interdisciplinary, but bibliometric analysis tends to be centered around one discipline, which may hinder the emergence of true output.

There is an expected high level of innovation in inter-disciplinary publications (Bromham, Lindell and Dinnage, Russell et al., 2016).

It is recommended that future researchers do the analysis utilizing metadata from additional relevant sources, such as the Dimensions and the like, to perform a comparative analysis.

## **6 Future directions**

Future research on climate change and migration should use longitudinal panel datasets for better causal inference, integrate high-resolution geospatial data for detailed insights, develop predictive models with machine learning to identify at-risk regions and also employ agent-based modeling to simulate subgroup migration patterns under different scenarios. The expertise planned should have experts from diverse backgrounds like climate scientist, economist, urban planners and sociologists.

It should adopt gender, age and disability-sensitive approaches to understand how these factors intersect with climate migration. Researchers must also highlight the role of indigenous knowledge and local adaptation in community-led efforts, and focus more on marginalized groups such as displaced persons, low-income groups and refugees, whose migration patterns are often underrepresented in current literature.

Researchers can also investigate how rural-urban migration trends, potentially accelerated by climate change, impact cities' infrastructure and services and explore ways to prevent inequality and the formation of "climate ghettos." Additionally, studies should focus on secondary and tertiary cities, which may face unique adaptation capacities and planning challenges compared to mega-cities. The division or categorization between cities becomes very crucial for developing countries where we also have semi-urban, rural (like in India). Future researchers could examine the formation of climate-induced slums in urban areas and identify solutions to integrate these displaced populations.

## **7 Contribution of authors**

Dr. Sukhamaya Swain: Scopus searches and VosViewer analysis, writing – original draft

Dr. Siddhartha Bhattacharya: Conceptualization, critical evaluation

Dr. Suman Goyat: Final review

Kashyap Pathak: Writing - review & editing

## **8 Conclusion**

This review of research trends on climate change and migration highlights the growing recognition of the complex and multifaceted relationship between environmental changes and human mobility. Over recent years, scholarly attention has shifted from viewing migration solely as a risk or a threat, toward understanding it as a potential adaptive response to climate-induced challenges. The literature underscores the importance of interdisciplinary approaches, integrating environmental science, social sciences, and policy studies to capture the nuanced drivers and consequences of climate-related migration.

There have been consequential issues like lack of international attention, absence of taxonomy and many more but slowly, Nature is forcing the planners and policy makers to improve research in this space. A large number of funding Institutions is an indication of shape of things to come and is a direct metric of measuring the interest.

Few questions to conclude: When can we finally dream of coordinated global attention by multilateral bodies like UN?

Can we have some intersection of climate refugees with sustainable finance.

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