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Between Two Epochs: The Climate Migration Paradox in the Anthropocene

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Abstract:
This paper explores the intersection of climate change and migration in the context of the Anthropocene by highlighting what is termed the 'climate migration paradox.' As global climate change accelerates, more people are displaced due to extreme weather events, rising sea levels, and ecological degradation. However, this phenomenon is paradoxical; while migration due to climate change is often seen as a necessary adaptive response, it also exacerbates vulnerabilities, especially in the regions impacted by historical inequities and geopolitical instabilities. By comparing the current Anthropocene epoch with the relatively stable Holocene epoch, this paper examines how the environmental shifts changed the nature of human mobility, primarily due to the Industrial Revolution, challenging the policy frameworks and humanitarian approaches. The paper aims to explore climate risk vulnerabilities, future migration trends, and potential solutions, along with long-term prospects for addressing climate change-induced displacement. It does so by analysing how migration in the Anthropocene diverges from the Holocene. The study emphasizes the need for interdisciplinary and cross-disciplinary approaches to understand and manage the climate migration paradox by bridging the gaps among disciplines to understand the man-environment relationship for sustainable and equitable solutions to address future migration pressures.

Keywords: Climate change, Displacement, Climate migration paradox, Holocene, Anthropocene

1. INTRODUCTION

Climate migration has been one of the major driving forces for the rise of human civilizations in the past. Following the recent glaciation period, the Earth has been continuously warming up for the past 11,700 years. This change in temperature had varying impacts on different parts of the globe, which led to the formation of rivers, downslope migration of the hunting-gathering people, and the rise of cultures and civilizations**.** In recent times, in the purview of rising temperatures, degrading ecosystems, extreme weather events, rising sea levels, and submergence of small Islands and coastal areas, climate change has been among the most discussed topics worldwide. The People from Pacific Island Nations like Kiribati and Tuvalu are relocating due to the submergence of islands caused by rising sea levels (Barnett & Webber, 2010); the people from the submerged and cyclone-hit Bangladesh are migrating to nearby towns like Dhaka (The World Bank, 2013; Hossain, 2016); and, prolonged draughts and desertification in the Saleh region of Africa is causing displacement of the farming communities from the area (Foresight, 2011; Brown, 2008). The above examples testify to the phenomenon of climate migration in recent times. The possible long-term result of the warming Holocene epoch led to the beginning of agriculture, domestication, and the rise of cultures and civilizations. However, ever since we started discussing the impact of the warming Anthropocene age, the issues of habitat loss, forced displacement, and increasing

population pressure over the resources have become widespread. Studying the beginning of the Holocene epoch and comparing it with the widely discussed Anthropocene Age creates a climate migration paradox. The main objective of this paper is to examine this paradox historically, to suggest long-term and practical mitigation strategies based on lessons from the past and innovative solutions for sustainable migration models.

2. Climate Migration in Historical Context

Historically, the climate has been one of the main driving forces for the out-of-Africa event in the history of human migration. The cyclic windows provided by interglacial periods led to the migration of human ancestors out of Africa to Asia and Europe during the Pleistocene epoch (Lisiecki & Raymo, 2005). Compared to the earlier period of the cold phase, the beginning of the Holocene epoch was marked by warm temperatures and a stable climate, which led to the melting of thick ice sheets and the formation of various river systems. This enabled cave-dwelling foragers to learn agriculture, have a settled life, and build cultures and civilizations. The warm and stable climate, permanent sources of water, and year-round habitation proved to be more suitable for the domestication of plants and animals (Alley, 2000; Lisiecki & Raymo, 2005).

The early Neolithic model of South Asia was provided by a relatively upstream pit-dwelling sites of Burzhom and Gufkaral in Kashmir. Mehargarh provided the guiding principles for the domestication of plants and animals, and was followed by a southward and downstream trend of transition towards the pre-Harappan and mature Harappan settled life. This rapid transition from a cave-dwelling hunting-gathering society to the rise of cultures and civilizations, driven by the domestication of plants and animals, has been termed the “Neolithic Revolution” by V. Gordon Childe (Childe, 1936). However, the Holocene epoch was a defining moment in history, not necessarily a progressive one, but a transformative one. It transformed the course of environmental migration and made human society more complex than ever before. It allowed Homo sapiens to settle, multiply and build civilizations, it also brought greater inequality, harder labour and vulnerability to famines (Harari, 2014). This marked the beginning of the first known phase of human history when people began actively shaping and controlling the environment- a never-ending process to date.

Towards the end of the Harappan phase, based on the archaeological remains, there is a clear indication of the abandonment of city life and migration towards the Gangetic plains. And, this eastward migration continued in densely forested regions of the mid and lower Gangetic plains during the Vedic and post-Vedic ages. The periods before the Anthropocene witnessed alternating cycles of relatively colder phases before the Industrial Revolution. The Anthropocene likely began during the Industrial Revolution, when human activity first began to overwhelm the natural Earth system (Crutzen & Stoermer, 2000).

The Industrial Revolution brought drastic changes in the environment due to the large-scale use of fossil fuels. It is characterised by the introduction of machine-based mass production. The spinning Jenny was replaced by power looms. It resulted in the exploration of fossil fuels and mining activities. There was a revolution in the transport system with the introduction of railways and modern vehicles. The production boom since the 1750s went high, and from that time, so did the population. This resulted in colonialism, imperialism, and globalization in recent times. The rising population revolutionised the power consumption as well. The 1970s and 1980s saw a new wave of awareness towards global warming and related problems. The Stockholm Convention in 1972 set the stage for global environmental governance. The Mauna Loa Observatory in Hawaii, as shown in Figure 1, estimates that the Carbon Dioxide (CO_2)

concentration in the pre-industrial era was 280 parts per million (ppm) before 1750. It went to 316 ppm in 1959, 429.93 ppm on June 8, 2025, and it is projected to go to 700 ppm by the end of this century. The changes in emissions are attributed mainly to uncontrolled mass production, intensifying agricultural practices coupled with intense use of pesticides, changes in land use patterns due to agrarian expansion, and unchecked urbanization. These all led to large-scale deforestation and population explosion, and vice versa. This also resulted in increasing pressure on resources, biodiversity loss, waste generation, biological invasion due to global trade and colonialism, disease, and pollution.

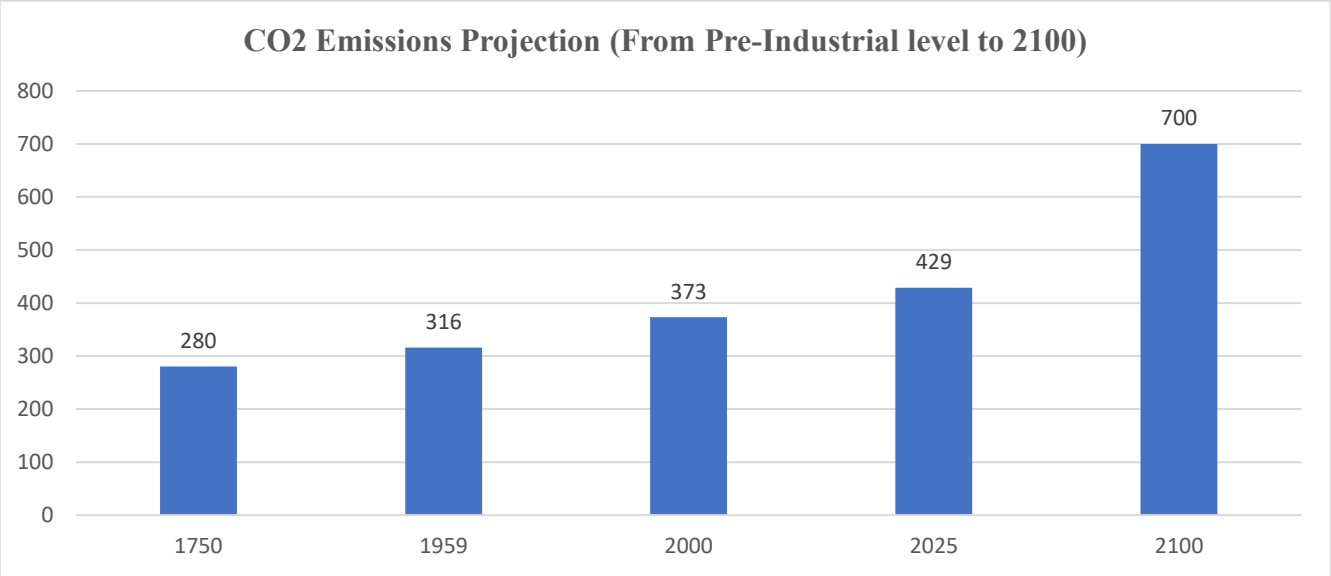

Figure 1: CO_2 Emissions Projection from Pre-Industrial Era to 2100.
Note: Graph created by the author using data from the Intergovernmental Panel on Climate Change (IPCC, 2001), NOAA (2025), and CO_2 Earth (n.d.).

3. Climate Migration in the Anthropocene

The rising sea level and desertification due to increased greenhouse gas emissions and global warming have become an undeniable fact in recent past. The United Nations Convention to Combat Desertification (UNCCD) and the World Meteorological Organization (WMO) identify key drivers of climate migration as urbanization, sea level rise, intensifying floods, and land degradation. The UNCCD reports that approximately 77.6% of the earth's land surface has become permanently drier, with 4.3 million km^2 added in the recent decades; drylands cover 40.6 % of the global land area, posing growing challenges to food security, water availability and sustainability; and highlighting the significant risk of climate induced displacement and ecological stress (UNCCD, 2024). The WMO State of the Global Climate reports that weather-related hazards such as floods and storms have displaced over 209 million people between 2011 and 2020, with displacement continuing to rise due to extreme heat, droughts, and cyclones (WMO, 2023, 2024).

These climate shocks have disproportionately affected vulnerable populations, undermining resilience and adaptation capacity in underdeveloped and developing regions. For example, in Africa, there are changing precipitation patterns, prolonged droughts, and land degradation that have contributed significantly to food security and internal migration (WMO, 2021). The agrarian community of the Sahel region of Africa is moving out of its habitat due to the threat posed by the extended drought seasons, posing serious challenges

to food security. The climate migration in the region poses a serious competition in the neighbouring areas, becoming a cause of conflict. Similarly, people of Small Island Nations are facing the problems of submergence of Islands and migrating to nearby countries. It is expected that this migration will pose a serious threat to resources in the nearby urban and semi-urban areas.

Studies using LiDAR-derived elevation data, assuming a 1 m rise in sea level by 2100, estimate that around 410 million people live in zones less than 2m above current sea level and thus face significant displacement risks (Olivia Rosane, 2021). The future migration projections show that the estimated population living in the dryland areas will reach 5 billion by 2100, from 2.3 billion today (UNCCD, 2024). It is also expected that the number of climate refugees will increase to 2 million or 20% of the world population by the end of this century (Geisler & Currens, 2017; Friedlander, 2017). The projections pose a serious threat to human society in multiple spheres.

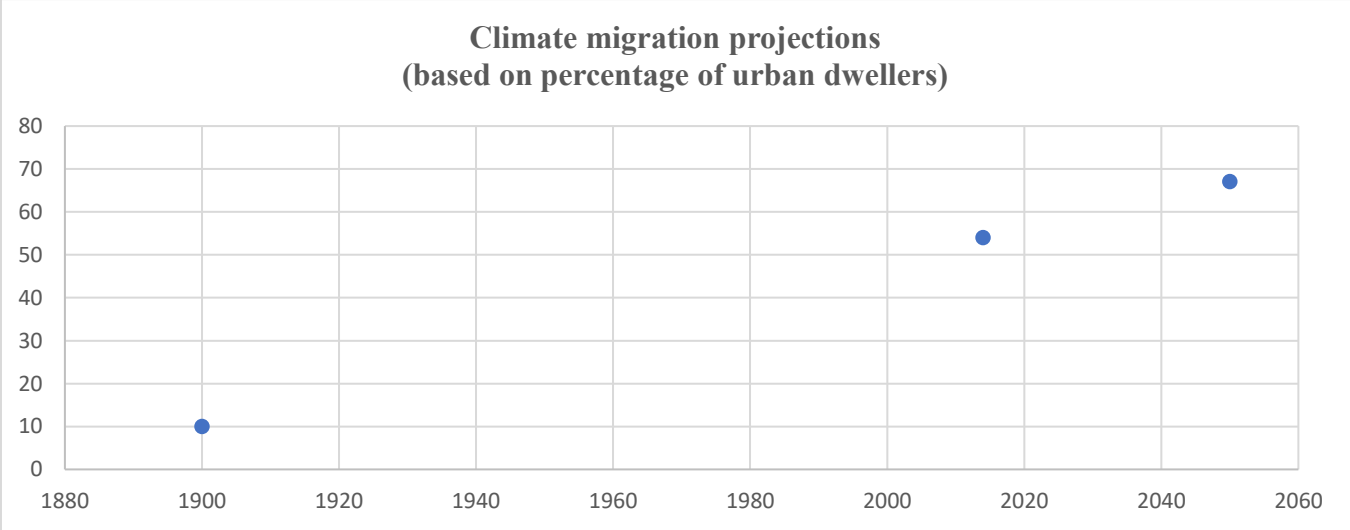

Figure 2: Projections of Urban Dwellers (UNCCD, 2024)

Figure 3: As shown in a 2011 photograph by Magee (DFAT), Kiribati faces existential threats from rising seas and storm surges (Photo: Erin Magee / DFAT).

4. Understanding the Climate Migration Paradox

While climate migration in the Holocene was seen as a necessary adaptive response to the warming temperature, it empowered humans to gain mastery over food production. In the Anthropocene, on the other hand, humans were forced to migrate to the metropolis and emerging towns, which led to increased pressure on resources, exposing them to climate vulnerability. Thus, creating a paradox in our understanding of the dynamics of migration for and due to climate change in the form of differential nature, scale, complexity, and the nature of challenges it poses, whereas it should have been treated as a necessary adaptive response as compared to the early Holocene.

The factors that exacerbated climate migration in the Anthropocene were different from the context that, in the early Holocene, the migration was driven towards the fertile floodplains of the rivers and was natural. The rivers like the Indus, Nile, and the Huang He facilitated early urbanization through fertile floodplains and water management (Macklin & Lewin, 2015). On the other hand, the Anthropocene climate migration is due to the unavailability of resources, particularly due to the complex problems of industrialization, globalization, political frameworks, hydrological problems, and extreme weather events. So, the Hydrological edge is now transformed into a hydrological problem. Taking the scant population of the early Holocene into consideration, it can be argued that the people who were migrating to the virgin lands were often fewer in number, and there were very few chances of cross-cultural clashes due to the arrival of a new population in the region. On the other hand, the scale of migration during the Anthropocene is huge, and it poses serious threats to the areas where they migrate.

In the Anthropocene, the extreme weather events due to climate change are driving the agricultural communities from their farmland to the nearby areas, as in the case of the Sahel region of Africa. Similarly, the small island nations are facing difficulty in coping with the rising sea level. These pose serious threats to the stability of the nearby regions, leading to serious problems of food security, political instability, and biodiversity loss due to increased aridity in the region. Lake Chad has shrunk by 90% since the 1960s due to prolonged droughts and unsustainable use of water (UNEP, 2011). Livelihoods of farmers, herders, and fishing communities have collapsed, leading to mass displacement, especially to northern Nigeria. This climate migration exacerbated Boko Haram recruitments and instability in the region (Okpara et al., 2015). Similar problems have been witnessed in the regions of Mopti and Segou regions of Mali; Burkina Fasso and Niger in the region.

The issues of rising sea level pose different challenges for the Small Island Nations; for them, it's more than losing a homeland! Kiribati, having an average elevation of less than 2 meters, facing the threat of land becoming inhabitable due to salinisation and storm surges, adopted the migration with dignity plan to buy land in Fiji in 2014 (Connell, 2015). The Maldives, Tulavu, and Marshall Islands are also facing the threat of submergence and are trying to highlight the issue in international forums again and again. The migration due to the submergence of these islands needs a huge economic cost to relocate the entire population to a new land.

The people from already inhabited lands, for example, in the case of coastal regions of India, Sri Lanka, and Australia, will face a multitude of existential threats from the outside communities settling there. The migration will also pose a serious threat to the environment and biodiversity of the region, as the increase in population will put extra pressure on the resources. The competition for resources will potentially lead to cultural, political, and linguistic clashes, and the economic vulnerability of the population is bound to rise. The whole dynamics of Anthropocene climate migration is much more complex than the Holocene migration. The early Holocene settlers were facing challenges in the form of topography, clearing

vegetation to make the land suitable for agriculture, potential threats from the wild animals of the new regions, and selecting suitable varieties of plants and animals for domestication. This gave rise to the complex institutions of the state, religion, and society. But those are now regarded as the necessary adaptive response, posing our understanding of the Anthropocene climate migration as paradoxical in nature because it is both cause and effect for climate change, and the situation is bound to be worsened if we don't understand and act accordingly.

5. The State of Mitigation and Adaptation Efforts

Most of the mitigation efforts are centred on minimising the greenhouse gas emissions to minimise the long-term impacts of climate change and reduce the future scale of climate displacement. International agreements, such as the Paris Agreement (2015), recognize climate as a driver of displacement and include a task force on displacement under Article 8 of the Warsaw International Mechanism (UNFCCC, 2015). The loss and damage fund under the funding mechanism was introduced at COP 27 of the United Nations Framework Convention on Climate Change (UNFCCC) in 2022 to support the vulnerable countries dealing with unavoidable climate impacts, including migration. Countries are also encouraged to consider climate action in their future policy frameworks and plans of action on different aspects (IOM, 2021).

The key mechanisms for adaptation to climate migration include planned relocation and managed retreat, ensuring dignity, compensation, and planning in relocation; building resilient infrastructures, especially the public infrastructures; regional mobility agreements and human mobility in adaptation planning. The Great Green Wall, in the case of sub-Saharan Africa, was introduced in 2007 to restore 100 million hectares of land. With nearly $20 billion in financing through the World Bank, African Development Bank (AfDB), and UNCCD, it restored 20 million hectares of degraded land in the Sahel region (UNCCD, 2021). The scattered and slow plans like this hardly succeeded in solving the fast-growing problem, which can be seen in terms of growing instability in the region.

The growing instability in world politics and the existential threat to the people affected are going to pose a serious threat to world peace in the coming years. There is a continuous stress on the polluters pay principle, which puts a moral obligation on the developed nations responsible for greenhouse gas emissions and climate change to pay for the transition, especially technology transfer and financial help. But the US president's walkout from the 2015 Paris Peace Conference, and on many occasions distancing world powers from the financial and technological aid, indicates a more critical phase to come in the future for the people affected. Community-led resilience efforts and micro-planning have very little potential to address the situation due to the global nature of displacement and limited financial access.

States like India are implementing the policy and regulatory frameworks, such as Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI) for mangrove conservation, Coastal Regulation Zones (CRZ) regulation for protecting coastal ecology, and investing in irrigation projects like the Indira Gandhi canal to irrigate the arid Thar desert area. But these initiatives are not sustainable in the long run. For example, the Indira Gandhi Canal successfully irrigates 2 million hectares of land in the Indian state of Rajasthan and results in increased vegetation, high soil moisture, and lower surface temperature. Between 1972 and 2010, the Vegetation Index in canal irrigated areas increased by 40% while land surface temperature decreased by 1- 1.5 degrees Celsius (Devanand et al., 2016; Roy et al., 2014). Though this may seem like a development, this is weakening the Rajputana Vortex responsible for creating a low-pressure zone and attracting the south-west monsoon through the Arabian Sea route. Thus, creating a monsoon deficit in the long run and creating a potential threat for the ever-fertile peripheries of the Indo-

Gangetic plains.

6. Future Prospects for Addressing the Climate Migration Paradox

An important step in order to manage the future migration crisis due to climate change is to understand the paradoxes- the paradox of cause and effect, and the paradox of short-term environmental gains versus long-term ecological harms. The unique case of building the Great Green Wall in the Sahel region indicates that it may provide immediate benefits to the local population, but it may become disastrous in the long run and for different regions as well. The river embankment policies have turned disastrous in countries like India, China, and the USA, as this has intensified the floods rather than actually controlling them (Duflo & Pande, 2007; Xu, 2011; Pinter et al., 2008). Legal frameworks and international cooperation on migration and refugees are needed to make sustainable rehabilitation plans for the people in distress. For the most affected people who are left with no option but to leave their homes due to climate change, there is a need for the international legal recognition of climate displacement. The current refugee convention (1951) doesn't give legal recognition to the 'climate-displaced persons.' It is time to recognise such a population nationally and internationally, as the number is expected to reach around 20% of the entire population on the planet by the end of this century.

Before the implementation of any environmental engineering and migration policy, a rigorous study of the region and all the dynamics it has played in the past for the neighbourhood should also be taken into consideration. The geographical boundaries should be respected instead of political boundaries. An inter-disciplinary approach and the use of cutting-edge technologies like GIS and remote sensing should be used to locate paleo-flood channels, vegetation patterns in the past, and the type of indigenous vegetation by analysing pollen from the past. The environmental clearance for infrastructure development needs to be done by taking a broader area into consideration, rather than just that locality. Reforestation and river linking projects also need to be done in accordance with the broader analysis of the regions. It is important to prioritise clean energy as a source of energy rather than consumption. For example, a major misconception about the use of e-vehicles as a clean energy initiative is that they are driving society by using clean energy, but in reality, most of these vehicles are recharged again and again with the energy produced in large thermal power stations. Since we are not so effective in managing climate, we need a well-directed and well thought climate refugee relocation policy.

7. Conclusion

Through this study, we find that our traditional understanding of climate migration is driven by the idea of vulnerability, and this was not the case with the Holocene migration. The Holocene climate migration was driven by an opportunity to have a settled life. This created a paradox in our understanding of the phenomenon. This paradox is driven by the idea of climate migration as an outcome of climate change, but in a real sense, it is functioning as an agent of change as well. Understanding this paradox in theoretical and policy frameworks and a coordinated, well-studied, and robust migration plan on the national and international level with the relevant organisations is the need of the hour. This can be done through a robust and long-term impact assessment before such migration drives, while keeping climate change at the centre. And that can be done by using a multi-disciplinary historical study of the region using cutting-edge technologies. More than migration, we need to focus on preserving the planet and the natural habitat of the people in question. There is a need for a global, coordinated effort to address the challenges of the climate migration in the Anthropocene.

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