Climate Change Migration: Perspectives from Current Research

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Debates in the Literature

- Migration has long been a human response to environmental and other changes.
- Researchers generally agree that environmental change is rarely a direct driver of human migration, but that it contributes to other push and pull mechanisms that are primarily driven by economic factors.
Debates in the Literature

- Researchers do not necessarily agree on whether migration in the context of climate change represents a failure of adaptation, or a continuation of age old patterns of human betterment.

Source: Dow et al, 2013. “Limits to Adaptation”
Figure 2  An adaptation limit to rice cultivation leading to loss of livelihoods and security of supply.

The question of the hour: at what point will rural subsistence farmers no longer be able to adapt *in situ*, and be forced to leave for cities and towns?

Climate change impact on migration

- **Sea level rise:**
  - Regional variation & subsidence
  - Salt water intrusion in aquifers

- **Water availability**
  - Increasing (in-migration)
  - Decreasing (out-migration)
  - Unpredictable (out-migration)

- **Extreme weather events**
  - Droughts
  - Heat waves
  - Violent Storms
  - Floods

Different Approaches to Understanding Climate Change Impacts on Migration

• **Historical analog**: What is the empirical evidence for migration being induced by climatic changes or extremes? Can a separate “climate signal” be detected at all?

• **Livelihoods focus**: How will climate change impact the natural resources and productive systems upon which many poor people depend?

• **Future impacts**: What are likely impacts? How many people live in areas affected? What proportion of those affected will migrate? How will the proportion vary by impact type?

• **Migration systems**: how will existing migration systems and drivers of migration be impacted by CC? (push, pull, intervening variables)
<table>
<thead>
<tr>
<th>Location</th>
<th>Event</th>
<th>Date</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Great Plains</td>
<td>Dust Bowl</td>
<td>1930s</td>
<td>Between 1935-37, 34% of the population moved out; 1 million people left between 1930-35, 2.5 million after 1935. Movers were more likely not to own land. Mostly, people moved nearby; about 300,000 moved to California, these flows dominated by young nuclear families with family connections in destination. Concomitant factors: overcapitalization of agriculture in the region, and economic depression from 1929</td>
</tr>
<tr>
<td>Northern Ethiopia</td>
<td>Drought</td>
<td>1970s and 1980s</td>
<td>No direct link was found between index of vulnerability and months until migration after the onset of the drought. Number, diversity and quality of household strategies were related to later departures; smaller families tend to leave earlier; high initial vulnerability, and fewer strategies at the beginning of the drought reduce households’ options (negative feedback spiral). Initial differences in the propensity to migrate— based on prior socio-economic and demographic household conditions— disappear over time as an absolute limit is reached in terms of water and food availability, and the in situ coping mechanisms fail.</td>
</tr>
<tr>
<td>Sahel</td>
<td>Drought</td>
<td>1970s and 1980s</td>
<td>Changes in rainfall patterns and droughts were linked to a decline in long-distance and international migration, and to an increase in short-distance and circular labor migration.</td>
</tr>
</tbody>
</table>

MIGRATION OUT OF 1930s RURAL EASTERN OKLAHOMA INSIGHTS FOR CLIMATE CHANGE RESEARCH

ROBERT MCLEMAN

The question of how communities and individuals adapt to changing climatic conditions is of increasing concern to scientists and policymakers. In light of the growing evidence that human activity has modified the Earth’s climate, many authors have suggested that changes in human settlement and patterns may occur in response to the impacts of human-induced climate change. As sea level change, changes in weather patterns, and increasing frequency of extreme weather events. While it is generally believed that changes in the natural environment can indeed influence human migration and settlement patterns, the nature of this relationship is not well understood, and the number of empirical studies is relatively few.

With this in mind, I undertook an investigation of how rural populations responded to a period of adverse climatic conditions in rural eastern Oklahoma during the 1930s, with particular interest in those households that adapted by migrating to rural California. This is not the first time that 1930s Oklahoma
Loss of livelihoods and long-term migration

- The breakdown of ecosystem-dependent livelihoods is likely to be an important driver of migration, especially *internal* migration.

- Climate change will exacerbate this situation unless vulnerable populations, especially the poorest, are assisted in building climate-resilient livelihoods.

- Focus of upcoming World Bank report
Meso-America

Impact of climate-related disasters on human migration in Mexico: a spatial model

Sergio O. Saldana-Zorrilla - Kristian Sandberg

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Livelihoods Approach
Mozambique: The double blow of floods and droughts.

Source: Stefan Keinberger, 2010, PhD dissertation
The index tracks increases in the probabilities of events relative to a 1 in 20 year return cycle for the same events under current climatology.

It includes indicators such as additional hottest years, additional driest years, and additional extremely warm / wet / dry seasons.

Multisectoral Hotspots of Impacts

Based on sector specific thresholds for climate change impacts in water, agriculture, ecosystems and health. The above map shows where 50% of GIM-GCM combinations agree on the threshold crossing in each sector, for a GMT change of up to 4.5 °C. Regions in light gray are regions where no multisectoral overlap is possible.

Climate-Demography Vulnerability Index

Red areas = high vulnerability, where current demographic growth vastly exceeds “climate consistent” population growth
Blue areas = low vulnerability, where population growth is lower than “climate consistent” population growth

Migration Systems

• How does climate change impact upon:
  – Push factors: conditions in region of origin related to state of the economy, political stability, natural resource availability, and entitlements
  – Pull factors: conditions in destination area such as job availability, higher wages, political stability, and resource availability
  – Mediating factors: policies in receiving countries/regions, ease of transport, family ties, economic ties, social/cultural ties

• Black et al. find that climate change almost solely impacts on push factors
Fig. 4. Circular plot of migration flows between and within world regions during 2010.

Source: Abel and Sander (2014), Science, 1520
Issues with the Four Approaches

• Historical Analogue:
  – Past experience is with deviations from the mean; in the future the mean will change
  – Is past necessarily prologue?

• Livelihoods
  – What happens in places (urban & developed) where populations are not directly dependent on local natural resources for survival?

• Future Impacts
  – What proportion of the affected population will leave?

• Migration Systems
  – Systems can alter owing to political events, as happened with the breakup with the Soviet Union and now Syria
Issues with Current Research

- Often not addressed:
  - Multiple stressors beyond climate change -- economic downturn, commodity prices, HIV/AIDS, disease outbreaks, political instability, and conflict -- are generally not taken into account
  - Potential direct displacement from major infrastructure projects (large dams to improve reliability of water supply & to reduce GHGs; dykes to reduce risk of seaward hazards) and their environmental impacts

- Rigorous analytical frameworks are only beginning to appear

- Complexity of human behavior and decision making
FUTURE WORK
## Estimated Magnitudes of Migration and Displacement

<table>
<thead>
<tr>
<th>Source</th>
<th>Climate Change Impact</th>
<th>Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myers (2002)</td>
<td>Droughts and other climate change events</td>
<td>50m by 2050</td>
</tr>
<tr>
<td>UNFCCC (2007)</td>
<td>Environmental impacts</td>
<td>50m displaced by 2010</td>
</tr>
<tr>
<td>Almería Statement on Desertification and Migration (1994)</td>
<td>Desertification</td>
<td>135m</td>
</tr>
<tr>
<td>Myers (2002, 2005)</td>
<td>Sea level rise</td>
<td>162m by 2050</td>
</tr>
<tr>
<td>Stern (2006)</td>
<td>Climate Change Impact</td>
<td>200m by 2050</td>
</tr>
<tr>
<td>Christian Aid (2007)</td>
<td>Climate Change Impact</td>
<td>250m to 1 billion</td>
</tr>
<tr>
<td>McGranahan, Balk and Anderson (2007)</td>
<td>Sea level rise (10 meters)</td>
<td>634m living below 10m sea level circa 2000</td>
</tr>
</tbody>
</table>

*The range is from 50 million to 1 billion - but often we have no idea how these numbers were developed!*

Estimated Magmites of Migration and Displacement

Global Environmental Change

Why the numbers don’t add up: A review of estimates and predictions of people displaced by environmental changes

François Gemenne

ARTICLE INFO

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Abstract

Estimates and predictions of people displaced by environmental changes have been highly instrumental in the media. Yet, estimates and predictions have become one of the most contentious issues in the literature. This article seeks to review the key estimates and predictions existing in the literature, as well as the methodologies they are built on and the problems and caveats they are fraught with. The focus is on the methodological difficulties in estimating the numbers of people displaced by environmental changes, while a second part examines the predictions for future displacement. The paper synthesizes the key methodological difficulties and suggests some possible avenues for improvement.

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Modeling Climate Migration

• **Gravity models** have been developed which seek to predict how migration behavior is influenced by a range of factors, including environmental changes, creating a surface that reflects spatial differences in economic opportunities.

• **Agent-based modeling (ABM):** Applied to model population movements associated with environmental changes in different regions. ABMs are well suited for modeling the links between environment change and migration by simulating responses of individuals, households or communities to environmental events. These models are based on the assumption that the results of individual actions may differ from the sum of the parts in a system characterized by interacting agents, emergent properties arising from agents’ interactions with each other. A set of rules govern these interactions, and these rules take into account people’s perception and experiences.

• **Indirect estimation** methods have been used to spatially estimate past migration using the population balancing equation, in which net migration in or out of an area can be viewed as the residual of population growth in a given period minus natural increase (births minus deaths). It is conceivable that this method could be used to extrapolate migration into the future, though probably only on the order of a decade or so.
Future Population Projections

Spatially explicit global population scenarios consistent with the Shared Socioeconomic Pathways

Abstract
The projected size and spatial distribution of the future population are important drivers of global change and key determinants of exposure and vulnerability to hazards. Spatial demography and key socioeconomic variables, together with projections of land use, energy use, and emissions, are widely used as inputs to spatial projections of future climate change and other climate-related phenomena as well as assessments of the impacts of extreme events, sea level rise, and other climate-related outcomes. To date, however, there are very few global-scale, spatially explicit population projections, and those that do exist are often based on simple scaling or trend extrapolation. Here we present a new set of global, spatially explicit population scenarios that are consistent with the new Shared Socioeconomic Pathways (SSPs) developed to facilitate global change research. We use a dataset of global population density for the five SSPs (2100), and (f–j) corresponding projected population change (2000–2100).

Figure 1. (a–e) Projected population density for the five SSPs (2100), and (f–j) corresponding projected population change (2000–2100).
Issues

• There remains a demand for “predictions” / forecasts of future climate displacement and migration by policy makers and the media

• Yet
  – Can we accurately predict large scale crisis migration (e.g., Syria, large number of migrants crossing the Sahara)?
  – Will this effort play into the hands of anti-immigrant politicians?

• Ideally, developing future scenarios of possible migration flows would emphasize the dire need for preventive mechanisms
  – Quickly brokering settlements in civil conflicts
  – Adaptation responses

As weather and climate-related disasters are becoming more frequent and destructive in Mexico, the model suggests that out-migration will continue to rise in the coming years if an active disaster prevention strategy and structural adaptation measures are not duly implemented.  - Saldaña-Zorrilla & Sandberg 2009
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THANK YOU!