**Land Degradation and Migration**

**Kathleen Hermans1)\***, **Daniel Müller1), David O'Byrne2), Lennart Olsson2), Lindsay C. Stringer3)**

**\***Corresponding author, email: khermans@iamo.de

**1)** Leibniz Institute of Agricultural Development in Transition Economies (IAMO)

Theodor-Lieser-Str. 2, D-06120 Halle (Saale), Germany

**2)** Lund University Centre for Sustainability Studies, Lund, Sweden

**3)** University of York, Heslington, York, YO10 5NG, United Kingdom

[stand first]

Land degradation threatens livelihoods with the potential to displace vulnerable groups, yet its impacts on migration are poorly understood as environmental migration research mainly focuses on the impacts of climate change on migration. We argue that addressing this gap is vital as land degradation poses risks for sustainability.

[main text]

Land degradation, defined as a decline in land condition that results in the long-term reduction or loss of biological productivity, ecological integrity, or value to humans due to climatic change and human activities [1], limits humans’ ability to safeguard livelihoods. Land degradation is a threat multiplier, exacerbating other risks and their impacts on livelihoods. This is often starkly seen in arid and semiarid regions where fertile land and water resources are particularly scarce. A quarter of the Earth’s ice-free land area is estimated to be already degraded, affecting one in six people globally and reducing the global annual gross domestic product by approximately ten percent [2]. This, in turn, increases socio-economic risks, especially in low- and middle-income countries, where livelihoods often are already precarious [1, 3]. Even though land degradation encompasses a specific set of processes and dynamics to be addressed through site-specific targeted knowledge and action, it remains a key challenge for sustainable development. Failure to adequately address land degradation has a broad range of consequences, including rising poverty and food insecurity.

Land degradation can fuel migration and displacement in low- and middle-income countries [2]. However, to what extent and how land degradation affects migration remains poorly understood. Researchers have identified the growing importance of environmental migration, which accounts for the diversity of population movements due to all types of environmental drivers [4]. In particular, the influence of climate change on migration has been intensively studied over the past two decades [5]. Key findings suggest that climate-related migration is multi-causal and context-specific, and opportunities for migration can differ substantially between people [6, 7]. Environmental migration outcomes range from voluntary migration to involuntary displacement and cover various forms of immobility, including so-called ‘trapped populations’ [8]. Despite the scientific and political spotlight on climate change as an environmental driver of migration, the role of land degradation as a threat multiplier has largely been ignored in environmental migration research [9, 10]. The few empirical studies that address land degradation and migration relationships yield contradictory conclusions, resulting from differences in geographic contexts, in manifestations and measurement of land degradation, and the temporal and spatial scales of analysis [11-15]. Consequently, robust evidence on how land degradation affects the intensity and patterns of migration is lacking [9, 10, 16]. This significant research gap needs to be addressed, given that land degradation is continuing and expected to increase, generating new risks for the affected populations.

We call for expanding the current research agenda on environmental migration to include land degradation in migration and displacement studies explicitly. In contrast to the wide-ranging climate changes covered by climate migration studies, land degradation involves distinct processes and dynamics, facilitating the development of targeted knowledge and policies to address migration driven by these factors. This distinction underscores the importance of incorporating land degradation in its various forms into the environmental migration research agenda. While concerns about the variety of different forms of land degradation are valid, advancements in remote sensing, geospatial data availability, and modeling techniques offer opportunities to quantify, analyze and understand site- and context-specific impacts of land degradation on migration considering a range of different variables and experiences. Inter- and transdisciplinary research approaches and methods, such as merging geophysical measurements with social science field data, can yield novel insights and permit causal examinations despite these challenges. Above all, the expansion of the environmental migration agenda regarding land degradation can directly benefit from harnessing the insights, experiences, and the theoretical and methodological advancements from recent years' climate migration studies [7]. We urge targeted policy support towards those populations who are most at risk due to land degradation, to foster sustainable development and secure livelihoods. To enrich migration studies with risks posed by land degradation, we suggest five research priorities.

**Research priorities**

First, research needs to be targeted towards better understanding people’s decision-making regarding whether to move or stay put. This requires understanding the socio-economic impacts of land degradation on humans, adaptation options for affected populations, and migration decision processes. Rather than focusing on whether land degradation causes migration, emphasis should be placed on how and in what situations it shapes mobility patterns. Such a focus would help to avoid deterministic narratives that ignore complex and conjunctural pathways between land degradation, agriculture, rural livelihoods, food systems, and migration. Redirecting attention to how migration decisions are taken in the context of land degradation requires accounting for varying levels of migratory agency while considering how prevailing social, economic, and cultural conditions and intersectional inequalities structure individual and household decisions, and hence, the ability to migrate. This would facilitate a better understanding of the broad spectrum of forms of mobility, including immobility. Theory development in the field of environmental migration that accounts for these aspects still remains rudimentary, which hampers scientific progress [17]. The aspirations-capabilities framework serves as a promising theoretical foundation for this purpose, as it covers varying degrees of choice and coercion, which may or may not result in migration [18].

Second, reliable and accurate monitoring of proxies for land degradation is essential for closing knowledge gaps on the extent and severity as well as the processes underlying land degradation [19]. However, land degradation is a complex and often value-laden process, which typically progresses gradually and with a subtle spectral footprint. Monitoring and measuring land degradation objectively and consistently over large areas is therefore challenging, and key uncertainties regarding the extent and severity of degradation remain. Together, this limits our spatial understanding of the role of land degradation in migration [1]. Specifically, remote sensing can only partially capture important aspects of land degradation, such as changes in soil structures, subtle land-use changes, and welfare impacts emerging from degradation. Expanding land degradation monitoring efforts towards ground-based and hybrid approaches, including citizen science approaches, is hence paramount for obtaining in-depth knowledge on the nuanced facets that shape land degradation on the ground [20]. Field data are crucial to define thresholds of types and degrees of degradation, validate the remotely sensed outcomes, and distinguish natural from human causes of degradation. Overall, greater efforts are required to develop new ways to systematically integrate various types of land degradation data, including indigenous and local knowledge. Indigenous and local knowledge augments remote measurements with deep insights that substantiate our understanding of individual and collective perceptions of changes in land degradation, which are essential in migration decision taking.

Third, it is crucial to leave disciplinary silos. We need to foster inter- and transdisciplinary collaborations, and cross spatial and temporal boundaries to better understand land degradation-migration linkages, and inform policy development. Because land degradation is difficult to define and measure, bridging environmental and social sciences is essential for monitoring land degradation and for assessing its societal consequences, including migration [21]. Few land degradation datasets are available ‘ready to use’. This contrasts with climate monitoring and modeling efforts, where longitudinal ground measurements for a growing number of meteorological stations are available and typically permit straightforward interpretation. The challenges associated with interpreting proxies for land degradation necessitate collaboration between migration scholars and land degradation data producers to ensure the provision of relevant data for analyzing, interpreting, and understanding migration processes. Crossing disciplinary boundaries will also facilitate the application of diverse data sets for understanding migration decisions in response to land degradation, when the measurements assess different variables at different spatial scales and over different time frames. Working across spatial and temporal boundaries is especially important because migration is often transboundary and may have time lags. Land degradation, driven by processes outside the degraded area (e.g., deforestation causing erosion and affecting water resources downstream), can lead to migration after local adaptation efforts have failed. A comprehensive understanding of the interconnectedness comes from considering data and analyses over various scales, time frames, and domains.

Fourth, besides including land degradation as a potential driver of migration, research also needs to account for the indirect and complex linkages between land degradation and climate change. Understanding their intertwined effects on human migration is essential for outlining robust policies and shaping effective responses to secure or improve livelihoods in affected regions. Land degradation gradually undermines livelihood systems, which consequently become increasingly vulnerable to climate shocks, such as droughts [9]. This might put affected people in precarious situations, lead to displacement and involuntary immobility, and could exacerbate land degradation in people’s destinations. So far, climate migration studies have been preoccupied with the effects of extreme events. However, land degradation may also render social and ecological systems increasingly vulnerable to gradual changes in climatic conditions, including longer-term changes in precipitation patterns. This potentially makes these systems increasingly unstable and thus prone to collapse, with likely consequences for mobility decisions [22].

Fifth, adequate and dedicated scientific funding is crucial to strengthen research on land degradation-migration linkages. Today, international and interdisciplinary funding schemes that support land degradation monitoring coupled with ground-based assessments to better understand migration dynamics and their underlying processes are largely non-existent. Current funding tends to either focus on environmental mobility more generally, without highlighting land degradation, or emphasizes climate change-migration linkages. For example, EU Horizon 2020 calls and the funding schemes of the AXA research foundation explicitly address climate-migration dynamics, whereas research grants on land degradation and migration have not yet emerged in the international research funding landscape. An exception is a recent call from the Belmont Forum on environmental migration that highlights land degradation, next to climate change. Rather than generating disciplinary competition for funding, interdisciplinary funding schemes should account for the combined effects of climate change and land degradation on mobility.

Moving away from degraded land can represent both an effective, proactive strategy to secure livelihoods and low-agency migration. However, the scarcity of empirical evidence on land degradation-migration linkages limits our understanding of the precise processes and mechanisms at play. This hampers an adequate consideration of land degradation in migration policies. Consequently, policy support for those people most at risk due to land degradation is often absent or insufficient, despite the variety of possibilities for addressing land degradation in its various forms. Our research priorities offer leverage points to advance the research agenda on environmental migration by prioritizing land degradation rather than neglecting it. This is paramount for an improved understanding of enabling factors and barriers to environmental migration, including the specific, and often indirect, role of land degradation. The resulting knowledge will help generate solutions to facilitate both voluntary mobility and immobility and reduce displacement and involuntary immobility in areas affected by land degradation.

**References**

1. Olsson, L., et al., Land Degradation: IPCC Special Report on Climate Change, Desertification, Land 5 Degradation, Sustainable Land Management, Food Security, and 6 Greenhouse gas fluxes in Terrestrial Ecosystems. 2019.
2. IPBES, The IPBES assessment report on land degradation and restoration, L. Montanarella, Scholes, R., and Brainich, A. (eds.), Editor. 2018: Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 744 pages.
3. Mirzabaev, A., J. Wu, J. Evans, F. García-Oliva, I.A.G. Hussein, M.H. Iqbal, J. Kimutai, T. Knowles, F. Meza, D. Nedjraoui, F. Tena, M. Türkeş, R.J. Vázquez, M. Weltz, 2019: , Desertification. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems J.S. P.R. Shukla, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.), Editor. 2019.
4. IOM, Migration and the Environment. Discussion Note: MC/INF/288, prepared for the Ninety-fourth Session of the IOM Council, 27–30 November 2007, Geneva. 2007.
5. Piguet, E., Linking climate change, environmental degradation, and migration: An update after 10 years. WIREs Climate Change, 2022. 13(1): p. e746.
6. Cattaneo, C., et al., Human migration in the era of climate change. Review of Environmental Economics and Policy, 2019. 13(2): p. 189-206.
7. Cundill, Georgina, et al. "Toward a climate mobilities research agenda: Intersectionality, immobility, and policy responses." Global Environmental Change 69 (2021): 102315.
8. Black, R. and M. Collyer, Populations ‘trapped’at times of crisis. Forced Migration Review, 2014. 45.
9. Hermans, K. and R. McLeman, Climate change, drought, land degradation and migration: exploring the linkages. Current Opinion in Environmental Sustainability, 2021. 50: p. 236-244.
10. McLeman, R., Migration and land degradation: Recent experience and future trends. Working paper for the Global Land Outlook, 1st edition. September 2017, 45p. Bonn: United Nations Convention to Combat Desertification. 2017.
11. Groth, J., et al., Investigating environment-related migration processes in Ethiopia – A participatory Bayesian network. Ecosystems and People, 2021. 17(1): p. 128-147.
12. Call, M. and C. Gray, Climate anomalies, land degradation, and rural out-migration in Uganda. Population and Environment, 2020. 41: p. 507-528.
13. Sanfo, S., et al. "Climate-and environment-induced intervillage migration in Southwestern Burkina Faso, West Africa." Weather, Climate, and Society, 2017. 9.4: p. 823-837.
14. López-Carr, David, et al. "A Conceptual Approach towards Improving Monitoring of Living Conditions for Populations Affected by Desertification, Land Degradation, and Drought." Sustainability 15.12 (2023): 9400.
15. Neumann, K., et al., Environmental drivers of human migration in drylands–A spatial picture. Applied Geography, 2015. 56: p. 116-126.
16. López-Carr, D., Agro-ecological drivers of rural outmigration to the Maya Biosphere Reserve, Guatemala. Environmental Research Letters, 2012. 7(4): p. 045603
17. Zickgraf, C., Theorizing (im)mobility in the face of environmental change. Regional Environmental Change, 2021. 21(4): p. 126.
18. de Haas, H., A theory of migration: the aspirations-capabilities framework. Comparative Migration Studies, 2021. 9(1): p. 8.
19. Xie, Z., et al., Using Landsat observations (1988–2017) and Google Earth Engine to detect vegetation cover changes in rangelands - A first step towards identifying degraded lands for conservation. Remote Sensing of Environment, 2019. 232: p. 111317.
20. Kelly, C., et al., Soils, Science and Community ActioN (SoilSCAN): a citizen science tool to empower community-led land management change in East Africa. Environmental Research Letters, 2022. 17(8): p. 085003.
21. Xie, H., et al., A Bibliometric Analysis on Land Degradation: Current Status, Development, and Future Directions. Land, 2020. 9(1): p. 28.
22. Olsson, L., et al., Ethics of Probabilistic Extreme Event Attribution in Climate Change Science: A Critique. Earth's Future, 2022. 10(3): p. e2021EF002258.

**Acknowledgements**

DOB and LO acknowledge support from UNEP/GEF Project 9825 'Large Scale Assessment of Land Degradation to Guide Future Investments in Sustainable Land Management in the Great Green Wall Countries', and European Commission’s Horizon 2020 Research and Innovation Programme. Project: ‘Linking Climate Change, Habitability and Social Tipping Points: Scenarios for Climate Migration’ (HABITABLE), Grant agreement number 869395. This article contributes to the objectives of the Global Land Programme (https://glp.earth).

**Competing interests**

The authors declare no competing interests.

**Author Contributions Statement**

K.H., D.M., L.O., D.O’B, and L.S. contributed to the conceptualization. K.H. led the writing and revisions. All authors contributed to the writing and revisions and gave final approval for publication.

**Caption for the stock image**

Land degradation threatens many livelihoods, potentially contributing to migration and displacement.