The Causes and Policy Responses to Forced Migration and Environmental Degradation in Africa

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Abstract

Forced migration has a complex relationship with the environment. The type of policy responses required to alleviate distress migration and improve the livelihoods of involuntary migrants while preserving the environment for broader society will vary by context. We highlight the need to better identify the related mechanisms underlying forced migration and their practices in receiving areas in an attempt to self-integrate. Implementation of safety net programs has risen. Such programs have the potential to promote migration as a risk management strategy and disincentivize the adoption of poor environmental practices in receiving areas. We discuss how available satellite data combined with machine learning approaches opens new opportunities to discover solutions to the migration-related environmental issues of Africa.

Keywords: forced migration, internal migration, refugees, environmental policy, Africa

JEL Codes: F5, F22, O15, R52, Q15, Q54

1. INTRODUCTION

The New York Times best captured an example of global indifference to African displacement and its consequences on human welfare in the publication of a photo on June 23, 2023. On display was a lost submarine used to transport five wealthy tourists to the Titanic wreckage juxtaposed by a fishing boat harboring refugees from Libya en route to Greece (Pérez-Peña 2023). Resources spent on search efforts for the submersible escalated, while scant recognition was given to the 750 refugees on the boat that eventually capsized. The prioritization of national resources in high-income countries to accommodate refugees from the Global North relative to the Global South suggests African refugees are tolerated rather than actively integrated in receiving areas (Reilley & Flynn 2022).

Although 52% of refugees originated from Afghanistan, Syria, and Ukraine in recent years, forced migration continues to affect the lives of Africans (UNHCR 2022). Twenty- seven million refugees have fled war and famine in sub-Saharan Africa (SSA) since 1975, and the region

provides residence to 1 in 5 of the globally displaced (UNHCR 2022). As shown in Figure 1, Africa hosts the largest number of forced migrants and at times, refugees, compared to the Middle East or South Asia, between 1950 and 2022. The World Development Report 2023 issues a call to action in addressing issues related to migration (World Bank 2023b). Promising policies are presented through the lens of migrants' motives (economic, refugee, distressed) and migrants' match with the destination economy. What is broadly missing from the evidence base and conceptualization to inform policy is the role of the environment.

As social scientists devote increasing attention to the role of climate in migration within Africa (Hoffman et al. 2021), less is known about what drives climate-affected mobility and immobility. We discuss why such knowledge is important for policy prescription and how we can learn from existing social safety net programs on the ability of targeted aid to promote private adaptation strategies. Similarly, in spite of the expansion of forced displacement scholarship (Dionigi & Tabasso 2022), knowledge about how the presence of refugees contributes to environmental degradation in receiving areas and what policies can be used to address such concerns remains limited (Alix-Garcia et al. 2013; Maystadt et al. 2020; Salemi 2021). The indirect effects of refugee-targeted interventions on the hosting environment is also largely unexplored.

New research directions are emerging in the space of environmental migration and potential policy responses. First, the measurement of human mobility in Africa has hindered research. We describe how the availability of satellite data and machine learning applications opens new opportunities for economic research in both migrant-origin and receiving areas. Second, the mounting pressures from air quality, wildfires, and deforestation suggest that future research is needed to identify instruments to accommodate migrants affected by these factors. Third, more attention should be given to the vulnerability of forced migrants to climate variability and disasters.

2. MIGRATION AFFECTED BY ENVIRONMENTAL CONDITIONS

2.1. Decision Rules and Labor Market Structure in Africa

Environmental migration as a research area attracts scholars across disciplines (Cattaneo et al. 2019; Hoffman et al. 2021; Huckstep & Clemens 2023). Different theories have been adopted to characterize these patterns. Insights from interdisciplinary scholarship have shaped prevalent theories used to describe human mobility (Massey et al. 1993; Taylor & Martin 2001). We reflect on the commonly used theories that motivate empirical applications of quantifying the migration-environment nexus.

The sustainable rural livelihoods framework casts decision-makers as selecting efforts across a portfolio of activities (agricultural intensification/extensification, livelihoods diversification, and migration) contingent on natural capital, financial capital, human capital, and social capital (Scoones 1998). Changes in natural capital, therefore, influence the relative return of migration compared to other activities in the choice set conditional on all capital endowments (Hunter et al. 2015). Neo-classical economic models feature individuals who maximize their perceived net benefit from working at their origin relative to an alternative destination. The benefits of moving relative to staying are captured in expectation and depend on the individual's subjective

probability of securing work and wage differential, noting discrepancies in perceived and actual outcomes can contribute to unemployment and slum expansion (Harris & Todaro 1970). The costs of moving include concrete (or measurable) factors such as the price of a bus ticket but may also account for psychic costs, e.g., moorings. These models were initially designed to explain rural-urban migration patterns. Climate variability, for example, can affect one's earning potential in the rural agricultural sector, making the opportunities in the urban, non-agricultural sector appear more desirable as it is assumed to be immune to climate risk. Cattaneo & Peri (2016) refine this conceptualization using a Roy model to explain why international migratory responses to temperature vary by origin country wealth.

Applications of the New Economics of Labor Migration (NELM) theories have gained traction in African case studies, given complex decision rules around livelihood strategies and the preponderance of seasonal migration in pastoralist and rural communities (Stark & Bloom 1985). Households are treated as joint decision-makers who sponsor members to migrate in pursuit of transfers that can be used to mitigate the risk to income caused by a poor environmental factor. Alternative frameworks have been used to accommodate marriage migration in an attempt to smooth consumption rather than income, where the receipt of transfers refers to a dowry or bride price (instead of remittances) (Rosenzweig & Stark 1989). A dynamic savings model has also been applied to distinguish temporary and permanent migration incentives in an environmentally vulnerable location. Immediate negative shocks drive temporary migration (which is consistent with assumptions underlying the NELM). In contrast, cumulative exposure (or the absence of shocks over time) influences decisions to invest in permanent, long-distance moves that require more financial capital but potentially yield higher returns (Kleemans, 2023).

We strategically review 15 studies conducted in Africa and other low- and middle-income countries (LMICs) to reveal the common mechanisms and enabling factors underlying such movement (Table 1). The literature tends to focus on one primary mechanism: income risk prompts agrarian households to send a member to migrate for work in an attempt to make income less reliant on the vulnerable agricultural sector. Exposure to storms and flooding poses an additional risk of infrastructure damage that can temporarily displace residents depending on its severity. There is limited empirical support that workers reveal their preferences for climate amenities by avoiding locations with poor environmental conditions (Marchiori et al. 2012). Case studies corroborate this narrative in middle-income countries, finding skilled workers and women assign a higher amenity value to clean air in China by migrating out of cities faster than other demographic groups (Khanna et al. 2021; Chen et al. 2022).

Greater discussion is needed around how constraints on labor markets can be removed for households to freely migrate and mitigate risk in Africa. Unlike in Latin America (Jessoe et al. 2018) and Asia (Colmer 2021), there are two types of constraints faced by rural households in Africa. First, wage labor markets are often too thin to accommodate the excess rural labor supply. Opportunities for diversification worsen as the negative income shock experienced

by farmers lowers the demand for goods and services, affecting non-agricultural labor demand (Mueller et al. 2020c; Liu et al. 2023). Second, weak wage labor markets also increase the opportunity cost of engaging in off-farm work. Households interested in engaging in migration are otherwise unable to outsource the work typically performed by the would-be migrant. Jagnani et al. (2021) show the labor requirements of weeding, pesticides, and fertilizers in Kenya accrue with temperature, raising the opportunity cost of migration, and this can cause households to retain family labor (Mueller et al. 2020b). We have seen that larger households overcome these challenges by selecting youth and male members who are not the household head to migrate (Gray & Mueller 2012; Baez et al. 2017). Such demographic groups have transferable skills off-farm and the opportunity cost of their absence may be lower than prime-aged adults or adults' whose presence is required to secure household use rights to land.

The type of environmental hazard can also affect the nature of work available to internal migrants. Widespread disasters or slow degradation of land productivity can decimate local opportunities for labor diversification (Gray 2011; Gröger & Zylberberg 2016; Baez et al. 2017; Chen & Mueller 2018). Baez et al. (2017) show the migration effect of a drought relative to a flood is fourfold. The more damaging hurricanes that might displace workers can attract resources in the form of humanitarian aid and increase the demand for construction labor, reducing incentives for internal migration (movement within the region or country). Social assistance and insurance can target flood-prone locations, shielding vulnerable households from damages (Mueller et al. 2014a; Peralta & Scott 2023). In contrast, droughts can be widespread and their duration can be uncertain. Some liquidate their assets to buffer consumption in the absence of credit markets (Lybbert et al. 2004). The asset-poor has limited options due to upstream linkages in Africa. Mueller et al. (2020c) illustrate that the relationship between participation in the non-agricultural sector and temperature is an inverted U-shape, which is entirely driven by enterprises reliant on agricultural inputs (Mueller et al. 2017). Any reduction in agricultural output caused by drought (or heat stress in their example) likely affects the ability of small-scale buyers and sellers of agricultural produce to work.

The lack of resilience in local labor markets suggests that international migration may be a relatively more desirable adaptation strategy for Africans. Such pursuits are restricted to the wealthy (Cattaneo & Peri 2016). The absence of financial capital (Call et al. 2017; Chen & Mueller 2018; Mueller et al. 2020a) and uncertainties around unemployment at the destination (Mahajan & Yang 2020) pose barriers to international migration (Martínez Flores et al. 2021). Conflict can amplify the migratory response to climate fluctuations (Missirian & Schenkler 2017; Mach et al. 2019). Immigration policies expressing leniency to refugees seeking asylum provide easier entry among climate-affected migrants from conflict-prone countries relative to other migrant-sending countries. Although Africans move within rather than across continents at a greater rate (Martínez Flores et al. 2021), attachment to place is pervasive. Even among those with strong aspirations to move, a high proportion are averse to moving to another country (Schewel 2020). Much fewer households in vulnerable communities respond to ex-ante climate risk relative to ex-post risk (Quiñones et al. 2023), which likely affects the selection of destination, employment, and when to return to the origin country. These factors suggest scope for research in behavioral economics to identify interventions that improve migration outcomes.

We still know little about how migrant households optimize welfare, whether expectations are myopic, how risk aversion plays a role, the extent to which loss aversion is prioritized when making investments relative to expected income, and how all these factors interact and vary by context (Batista & McKenzie 2021).

2.2. Which Policies Foster Migration Adaptation Strategies?

Migration patterns are consistent with the demand for a normal good (Clemens & Mendola 2020; Hidrobo et al. 2022). Economic development and educational investments at the origin will increase workers' occupational and geographic mobility. Natural disasters tend to accelerate patterns of international migration among skilled workers in wealthier LMICs (Drabo & Mbaye 2015; Cattaneo & Peri 2016). Programs that enhance financial and hu- man capital, strengthen access to labor markets, and secure the demand for non-agricultural goods and services by protecting vulnerable populations' income will spur migration among the asset poor. Are development programs facilitating adaptive migration by providing cash to beneficiaries to finance the move or by securing the off-farm employment opportunities of prospective migrants at an aggregate scale by protecting the demand for non-agricultural goods and services in rural areas? We focus on two new research avenues for policy evaluation.

2.2.1. Cash Transfers. Cash transfers (CTs) increase migration among beneficiaries (Stecklov et al. 2005; Angelucci 2015; Hidrobo et al. 2022). Few studies condition effects by environmental exposure. Mueller et al. (2020a) show CTs increase men's probability of migrating short distances in Zambia during cooler temperatures. Beneficiary households use their savings to take advantage of agricultural wage work while remaining close to the household. Chort & de La Rupelle (2022) evaluate the relative migration effects of receiving disaster funds and a CT on migration amid multiple disasters in Mexico. Disaster funds induce the retention of workers amidst hurricanes, droughts, and heavy rains, while CTs yield ambiguous effects.

The presumed primary mechanism is financial capital, facilitating a migratory response to risk. An alternative avenue of research would be to identify ways to reduce the opportunity costs of migration. In their review, Asfaw & Davis (2018) note beneficiary households tend to hire more labor and adopt labor-saving technologies. Which investments complement migration remains poorly understood (Bustos et al. 2016). Educational investments may be a complementary investment to migration. CTs mitigate maladaptive practices such as removing children and adolescents from schooling due to the increased demand for paid and unpaid work (De Janvry et al. 2006; Fitz & League 2021). Documenting how CTs assist youth in accumulating human capital and its subsequent effect on migration decisions would require a longer period of evaluation to account for adaptive responses to rare events.

Expectations on the availability of migrant work influence immobility. CTs increase non-food expenditures among beneficiary households, perhaps affecting the market for non-agricultural goods and services (Hidrobo et al. 2014; Handa et al. 2018). Macours et al. (2022) discovered that CTs incentivize beneficiary households to engage in non-farm self-employment amid a drought. A natural question becomes whether the boom among beneficiary households stems from spillover effects on consumer markets. Recent work finds the earnings among non-farm

enterprises grew in areas receiving CTs in Kenya as consumption benefits were realized among non-beneficiary households (Egger et al. 2022), yet consumption was compromised in Mexico and the Philippines due to perverse effects on prices (Cunha et al. 2019; Filmer et al. 2023).

Having a network at the destination may play a greater role when deciding to migrate for wage labor (Munshi 2003; Mahajan & Yang 2020). Bryan et al. (2014) used a transportation subsidy to nudge people to migrate during the lean season in Bangladesh, which increased migration over time. Non-beneficiary households were inspired to migrate to smooth consumption (Meghir et al., 2022). This shows the potential for sustained CTs to solidify migrant networks and sustain adaptation. Scaling up the program proved challenging (Huckstep & Clemens, 2023), but the study highlights the potential of CTs to bolster social capital and promote more long-term investments in migration.

2.2.2. Employment-Oriented Programs. Cash-for-work (CFW) and CT programs are often considered in tandem. A reason to consider CFW separately is that exchanging income for employment provides income and work experience to individuals who might otherwise be inactive. Gazeaud et al. (2023) find that CFW-induced migration rates in Comoros. CFW relaxed liquidity constraints and changed perceptions regarding risky investments. Flexible conditions enabled households to allocate the labor of members with lower contributions to household production and skills (e.g., women, the elderly, the less educated, and those inexperienced with migration) to migrate for work. Hoddinott & Mekasha (2020) evaluated CFW where drought-prone areas were targeted in Ethiopia. Beneficiary households retained adolescent and young women. Offering employment opens alternatives to consumption smoothing beyond engaging in marital markets but has little effect on employment-related migration.

Huckstep & Clemens (2023) suggest expanding information about employment and offering skills through vocational training can help. Providing information about wage potential increases migration in Ethiopia (Abebe et al. 2016) and Kenya (Baseler 2023). Evidence of the efficacy of training is preliminary and restricted to non-African contexts. Information and training can still affect actual (and intended) migration decisions. Yet, workers facing employment in a large informal sector might be more responsive to financial literacy, micro-credit, or training tailored to non-farm enterprises (Huckstep & Clemens, 2023). Evaluations are short and fail to offer insights into the ability to improve the working conditions of those averting risk. While enforcement of human trafficking violations is fundamental, there is scope for research around identifying applications that give migrants information about the working conditions prior to travel, the quality of intermediaries, or ratings of the experiences of employers in migrant networks to increase their probability of securing decent work (Bazzi et al. 2021; Huckstep & Clemens 2023).

3. FORCED MIGRATION AND THE IMPLICATIONS ON THE ENVIRONMENT

3.1. The Consequences of Hosting Forced Migrants

Since 2010, there has been a boom in the literature that assesses the consequences of forced migrants in receiving areas (Maystadt et al. 2019; Verme & Schuettler 2021).[1] The early quantitative literature has mainly focused on goods and labor markets (Alix-Garcia & Saah 2010; Maystadt & Verwimp 2014; Kadigo & Maystadt 2023). The picture that emerges early on is that forced migrants contribute to hosting economies, but there are distributional effects. In a context of imperfect labor and credit markets, the poor (vulnerable to health, agricultural, and macroeconomic shocks) remain less likely to seize new livelihood opportunities following the influx of migrants due to constraints on physical and human capital. The recent exodus of refugees from the Middle East (Tumen 2016; Fallah et al. 2019) and Latin America (Caruso et al. 2019) has generated new directions in the literature, particularly focusing on their participation in business creation (Akgunduz et al. 2018; Altındağ et al. 2020) and crime (Kayaoglu 2022) and their role in outbreaks (Ibáñez & Rozo 2020; Dagnelie et al. 2023). However, beyond a few qualitative case studies (UNHCR 2022; Ronald 2020), the environmental consequences of forced displacement have been largely missing.

Table 2 provides a select overview of recent studies that focus on the implications of forced migration on changes in land quality, air quality, and water quality. The presence of refugee's correlates – and, arguably, causes – the loss of vegetation, especially dense forests. To date, only three articles employ a design that enables causal inference: Maystadt et al. (2020), Salemi (2021), and Dampha et al. (2022). Whereas Maystadt et al. (2020) use an instrumental variable approach, the remaining works apply difference-in-difference designs. Across 49 African countries, Maystadt et al. (2020) find that the presence of refugees tends to be associated with a slight increase in vegetation cover and a rise in deforestation. The authors analyze auxiliary outcomes to demonstrate the rise in vegetation cover stems from the expansion of agricultural land in refugee-hosting areas rather than land clearance or biomass extraction. Salemi (2021) refines the spatial resolution of the unit of analysis and discovers modest forest loss at a more local level. In a very different context (Bangladesh), Dampha et al. (2022) also find evidence of deforestation due to settlement expansion. Still, the exact mechanisms remain speculative. The most popular explanations are the conversion of forest to settlement and built-up areas as well as the conversion of forest to cropland. Scholars discuss the reliance on firewood as an additional factor contributing to deforestation. Other moderating variables, such as reforestation programs, the selection effects of settlement location, and the availability of alternative fuel sources (such as liquified petroleum gasoline) have yet to be examined.

Few studies evaluate the impact of migrants – especially forced migrants – on air quality, with case studies restricted to the U.S. Such studies reveal areas with larger immigrant populations share similar (Cramer 1998; Price & Feldmeyer 2012) or obtain lower levels of pollutants (Squalli 2010; Ma & Hofman 2019) than areas with smaller immigrant populations. Migrant sorting into cleaner communities offers one rationale for the observed results. Turning to a singular non-U.S. example, Alshirah et al. (2021) found higher concentrations of heavy metals in the densely populated segment of a refugee camp in Jordan. The authors attribute the air quality

[1] Dionigi & Tabasso (2022) show that it goes well beyond economics, with an increase also observed in sociology, legal studies and health studies.

differential to ‘anthropogenic activities’, e.g., vehicle emissions, yet later conclude, ”there [is] no major air pollution within the camp.” Thus, evidence linking immigration to air quality is, by and large, inconclusive.

More attention has been directed to relating refugee density, water supply, and water quality. The additional population strains weak sewage and water systems (Jaafar et al. 2020; Wreikat & Kharabsheh 2020). Aksoy & Tumen (2021) analyze observational data in Turkey to highlight that constraints induced on waste and sewage are mediated by the quality of local governance. Refugee-hosting provinces with higher quality of governance invested in new waste treatment facilities. The state of our knowledge would benefit from more studies that permit causal inference and designs that allow for the identification of specific bottlenecks and solutions to migrant-induced environmental problems.

3.2. Policies that Better Integrate Refugees

Policies towards forcibly displaced people, and in particular refugees, have experienced major changes since 1951. Asylum and refugee policies have become more liberal along five dimensions: the ease of entrance and security status (access), the provision of public services and welfare (services), the ability to work and own property (livelihoods), encampment policies (mobility) and citizenship and political rights (participation) (Blair et al. 2022). As shown in Figure 2A, the liberal nature of these policies increased continuously since 1951 in Africa. Uganda is often an example of a country with one of the most progressive refugee policies. Most refugees live on settlements (not in camps), with more permanent housing structures and land provided to help attain self-sufficiency (Kadigo & Maystadt 2023). Refugees in Uganda also have freedom of movement and association, the right to find or establish jobs/employment, the right to access social services, including education and health, and a right to own property and access land, among others (Betts et al. 2017, 2019). In addition to Uganda, Ethiopia has adopted relatively welcoming policies toward refugees. In 2010, Ethiopia allowed Eritrean refugees to move out of camps with Ethiopian sponsors. Since then, the out-of-camp policy has been extended to other nationalities and work permits have been provided to refugees with permanent residence (World Bank 2023a). Zambia, Cameroon, Kenya, and Burkina Faso also rank highly in asylum liberality (Figure 2B).

Refugees in countries that adopt such policies tend to positively impact the local economy (Maystadt & Verwimp 2014; Alix-Garcia et al. 2018; Kadigo & Maystadt 2023). In-house policy adoption and proliferation may be a result of the favorable outcomes generated by refugees. It is, therefore, hard to establish a causal relationship. So far, research has been limited in understanding the role of diverse policy options in promoting local economic development or in mitigating detrimental impacts associated with large migration streams. We also miss systematic evidence on: i) the impact of specific policies or interventions to better integrate migrants in their host communities; and ii) how this might further protect the environment. We reflect upon a few promising interventions below.

3.2.1. Food Aid, Cash Transfers, and Land Programs. Food aid is a measure by one country to provide food in the form of in-kind or cash transfers to a recipient country without

reimbursement. Food aid addresses the most basic needs of people in hunger. To tackle food insecurity in other countries, the U.S. alone spent $4.9 billion on food aid in 2021 (USAID 2022). The aid included cash, food vouchers, and approximately 2.5 million tons of in-kind food. Recipients consisted of peaceful countries like Kenya and countries with violent conflicts like Afghanistan. In cases where governments provide food aid without conflict, food aid cushions the impact of natural disasters by promoting food security (Annen & Strickland 2017). Cash-based transfers have also shown efficiency in improving food security among refugees in Kenya (MacPherson & Sterck 2021; Delius & Sterck 2020), Rwanda (Alloush et al. 2017), Ecuador (Hidrobo et al. 2014), Lebanon (Salti et al. 2022; Altındağ & O'Connell 2023) and Turkey (Özler et al. 2021).

Refugees may be inclined to extract forest resources or change the landscape when rebels confiscate targeted aid. The literature highlights examples of rebels coercing refugees into movements through leveraging their control over aid distribution (Findley et al. 2011; Wood & Sullivan 2015). Scholars are in disagreement over whether food aid actually perpetuates acts of violence (Nunn & Qian 2014; Mary & Mishra 2020; Bluhm et al. 2021). Using an improved design over previous work (Nunn & Qian 2014), Christian & Barrett (2017) show a reduction in the likelihood of conflict at least in the context of U.S. food aid. Independent of the relationship between aid and violence, there are other channels in which the influx of resources may give refugees incentives to change the landscape. For example, the influx of refugees has been shown to be associated with higher prices on aid and non-aid goods in Tanzania, which could encourage refugees to clear land for production (Alix-Garcia & Saah 2010). More studies are needed to understand the indirect consequences of such refugee-targeted interventions on the hosts, particularly their environment. Cash-based interventions do show promise in deterring deforestation in other contexts and in locations peripheral to forests (Alix-Garcia et al. 2019; Ferrero & Simorangkir 2020).

There are few studies equipped to evaluate the impact of land reform on the food security and land use patterns of forced migrants. Mueller et al. (2014b) examine the welfare impact of a land resettlement program among participants in Malawi. Beneficiaries realized large gains in the form of increased production and food insecurity from relocation through accessing additional land. With an explicit focus on refugees, Zhu et al. (2023) find that receiving areas benefit significantly from the provision of land to forced migrants in Uganda. These programs are predicted to have rather short-lived effects on the recipients. Thus, it is unclear whether they may lead to a significant change in the environmental landscape.

3.2.2. Right to Work and Mobility. The World Development Report promotes refugees' mobility and right to work as policy responses to massive refugee inflows. Most studies focus on refugees living in camps – representing approximately 40 percent of the population (Verwimp & Maystadt 2015) – while globally, most refugees in developing countries live outside camps. There is little doubt that forced migrants also respond to economic incentives (Beine et al. 2021). When refugees are allowed to select their places of residence, they can certainly lead to a better skill match and maximize the benefits of existing networks (Arendt et al. 2022). Although not much investigated, another advantage of relaxing mobility constraints might be reducing the

incidence of land clearance, land change, and environmental degradation. Furthermore, the right to work has long been recognized as a key ingredient of successful refugee policies. Columbia is a case in point. By providing more than half a million displaced Venezuelans with access to the formal labor market (and other services), Colombia has improved refugees' welfare (Ibáñez et al. 2022) while having a limited impact on their natives (Bahar et al. 2021). Although with a strong redistributive effect, Bousquet & Maystadt (2023) even found that granting work permits positively affects the hosts' formal wage earnings. The same authors document the ability of (some of) the hosts to move to more skill-intensive and stable occupations and to industries not directly targeted by the work permits. As far as we know, there is no evidence related to the environmental consequences of such right-to-work policies.

4. WAYS FORWARD

Our literature synthesis suggests that evaluations of broader development programs on adaptive migratory responses are limited in Africa. There are at least 20 CT/CFW programs (Bastagli et al. 2019) and many more small-scale experiments piloting the concept in SSA (e.g., Hidrobo et al. 2022). Leveraging these studies to examine how cash affects migration, complementary investments, and factors that influence the decision when faced with risk would improve our understanding of the role of policy in facilitating the use of migration as an adaptation strategy.

In turn, emerging literature provides preliminary evidence that the environment might be structurally changed in refugee-hosting areas. The concentration of refugees can create pressures in receiving areas with scarce resources. Nearby forests present opportunities to harvest biomass for fuel and housing or clear land for agricultural production. Change in landscape conditions will ultimately depend on the economic opportunities available to refugees and what resources are provided to sustain food and energy consumption. Offering cash transfers, the right to work, or the freedom to move may be important pieces to solving the deforestation problem. Next, we highlight where we think environmental economists might contribute using the data and insights from other disciplines.

4.1. Non-Traditional Methods of Migration Measurement

The widespread usage of mobile phones and cellular network coverage in Africa has generated new mobility data sources. Call detail records (CDRs) and geotags posted to social media (social media applications) provide new opportunities to measure (latent) migration decisions (Lu et al. 2016; Beine et al. 2021; Milliff & Christia 2023). The infrequent surveying of individuals in LMICs, especially in the wake of conflict and natural disasters, has limited scholars' ability to trace irregular migration patterns. Most studies in the literature do not use a common definition of migration, nor are they able to isolate patterns of economic (voluntary) versus environmental (voluntary and involuntary) migration due to variations in survey instruments. CDRs and data scraped on social media apps provide a consistent means to collect high-frequency panel data on the whereabouts of individuals over time. Still, these forms of data collection suffer from additional disadvantages which warrant consideration.

CDR data remain inaccessible to most scholars, as they require special permission and arrangements for extraction through a network provider. Individuals who manage to gain access

to the data are often required to focus on a narrow sample (in terms of geographic or temporal scale) given the frequency of CDRs per individual and the amount of processing needed to create the appropriate dataset for statistical modeling. Sample selection bias may occur in locales with a diversified network provider portfolio. Putting access and selection bias aside, CDR data often lack detailed information about the owner of the mobile phone. CDRs aid in describing migrant flows following a disaster but preclude determining which sub-populations are vulnerable (Lu et al. 2016). Even when CDRs may be compiled with owner demographic information, measurement error may arise in countries where a single SIM card is shared by multiple users.

The use of data from social media apps overcomes the accessibility problem, as it merely requires knowledge of how to scrape information from the site. However, analysis of the data should also be interpreted with caution, given selection and reporting biases. The most vulnerable may not have access to the tracked communication technology. Reporting biases may arise from users of accounts misrepresenting themselves either in terms of their demographic profile or altering settings that grant the site permission to automatically update or track the user's location information.

Geographers are currently developing machine learning approaches using existing satellite and demographic data to identify potential patterns of population exposure to natural disasters (Kugler et al. 2019). Residential information (e.g., census data) is combined with other administrative data sources (commuting data) to improve upon the spatial granularity of coarse data and the distribution of exposure by accounting for seasonal and temporal cycles of worker movement (Freire et al. 2013). Few studies extend these techniques to monitor migration in crises, especially in Africa (Bharti & Tatem 2018; Enenkel et al. 2019). While these approaches show promise in measuring migratory flows attributable to disasters and conflict, they are at the nascent stage – mainly appropriate to capture displacement from rapid onset (rather than slow onset) events and still face limitations in terms of identifying important attributes of the exposed population. Furthermore, additional processing may be required to account for measurement error when using these variables in regression analysis (Alix-Garcia & Millimet, 2023; Proctor et al., 2023).

4.2. Wildfires as a Mobility Factor

Human-induced forest and land fires in Africa contribute to global emissions. Forested areas are cleared through burning to provide arable land to newcomers (Wan & Roy, 2023). The removal of crops and residual waste is often handled through igniting fires (Zhao et al. 2021). An overall reduction of controlled fires as a form of land management and the prevalence of highly flammable tree plantations also contribute to the growing threat of wildfires (Goldammer & Stocks 2011). Although the majority of fires are based on human activities, climate change will create more fire-prone conditions and the incidence of natural wildfires caused by lightning will vary with the duration of wet and dry seasons (Senande-Rivera et al. 2022).

Measurements of wildfires' social and economic impacts have surged as access to satellite-based data facilitates monitoring global exposure (Heft-Neal et al. 2018). As these losses become more salient to residents, we expect mobility patterns to change. Thus far, analysis of intended or

actual migratory responses to wildfire exposure has been limited to the U.S. (Winkler & Rouleau 2021; Berlin Rubin & Wong-Parodi 2022). Of key relevance to the African context is using regulation to affect incentives to migrate into forested areas for employment, which triggers land clearing. Extending impact evaluations of the enforcement of environmental and zoning regulations (Nelson & Chomitz 2011) or offering cash transfers in areas on the periphery of forests (Ferrero & Simorangkir 2020) to African case studies will be crucial to develop a better understanding of migration-wildfire dynamics as well as to reduce global emissions.

4.3. Vulnerability of Forced Migrants to Climate Change

Although the relationship between climate and conflict continues to be debated (Mach et al. 2019), conflict-driven displacement may pose additional risks to refugees in the form of increased exposure to climate variability and disasters (Peters 2021; Neef et al. 2023). Exposure can occur through transit when moving and inhabiting temporary shelters in cold winter, hot summer, or monsoon seasonal environments (Peters 2021). Temporary residences in floodplains or mountainsides in an attempt to avoid conflict often leave refugees subject to flooding hazards, landslides, and cascading displacement, a continued cycle of migration (Peters 2021; Neef et al. 2023). Diminished coping capacity due to asset liquidation and the dissolution of social networks can elevate their vulnerability in new locations (Peters 2021). Peters et al. (2019) argue that, in places lacking strong governance and institutional capacity, practitioners and policymakers should promote a network approach contrary to typical disaster risk reduction (DRR) frameworks, which involve using the state (or national governments) as an entry point. They emphasize the importance of improving DRR outcomes through interventions that manage risk (e.g., drought risk management, and food security management). Systematic research is needed on designing effective policies and programs to augment DRR more broadly (Peters et al. 2019). Remote sensing tools can identify which refugee populations are vulnerable to current and future climate risks (Van Den Hoek et al. 2018; Owen et al. 2023). Research is beginning to explore the effects of reformed safety net programs on refugee populations vulnerable to frequent disasters (Nobre et al. 2019; Balana et al. 2023). Expanding anticipatory cash transfer programs would provide more understanding of how safety nets can be used to mitigate temporary displacement and protect at-risk populations.

DISCLOSURE STATEMENT

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LITERATURE CITED

Abebe G, Caria S, Fafchamps M, Falco P, Franklin S, et al. 2016. Curse of anonymity or tyranny of distance? the impacts of job-search support in urban ethiopia. Work. Pap. 22409, Natl. Bur. Labor Stat. https://www.nber.org/papers/w22409

Akgunduz YE, van den Berg M, Hassink W. 2018. The impact of the Syrian refugee crisis on firm entry and performance in Turkey. World Bank Econ. Rev. 32:19–40

Aksoy CG, Tumen S. 2021. Local governance quality and the environmental cost of forced migration. J. Dev. Econ. 149:102603. https://doi.org/10.1016/j.jdeveco.2020.102603

Al-Harahsheh S, Al-Adamat R, Abdullah S. 2015. The impact of Za'atari refugee camp on the water quality in Amman-Zarqa basin. J. Environ. Prot. 6:16–24

Alix-Garcia J, Bartlett A, Saah D. 2013. The landscape of conflict: IDPs, aid, and land use change in Darfur. J. Econ. Geogr. 13:589–617

Alix-Garcia J, Millimet D. 2023. Remotely incorrect? accounting for nonclassical measurement error in satellite data on deforestation. J. Assoc. Environ. Resour. Econ. 10:1335–67

Alix-Garcia J, Saah D. 2010. The effect of refugee inflows on host communities: evidence from Tanzania. World Bank Econ. Rev. 24:148–70

Alix-Garcia J, Sims K, Orozco-Olvera VH, Costica L, Fernandez Medina JD, et al. 2019. Can environmental cash transfers reduce deforestation and improve social outcomes? a regression discontinuity analysis of Mexico's national program (2011-2014). Policy Res. Work. Pap. 8707, World Bank Dev. Res. Group. https://doi.org/10.1596/1813-9450-8707

Alix-Garcia J, Walker S, Bartlett A, Onder H, Sanghi A. 2018. Do refugee camps help or hurt hosts? the case of Kakuma, Kenya. J. Dev. Econ. 130:66–83.

Alloush M, Taylor JE, Gupta A, Rojas Valdes RI, Gonzalez-Estrada E. 2017. Economic life in refugee camps. World Dev. 95:334–47

Alshirah M, Aljaradin M, Jiries A, Shatnawi A. 2021. The air, water, and soil quality in the surrounding of Zaatari refugee camp Sustain. Resour. Manag. 6:1–16

Altındağ O, Bakı¸s O, Rozo SV. 2020. Blessing or burden? impacts of refugees on businesses and the informal economy. J. Dev. Econ. 146:102490.

Altındağ O, O'Connell SD. 2023. The short-lived effects of unconditional cash transfers to refugees. 2023. J. Dev. Econ. 160:102942.

Angelucci M. 2015. Migration and financial constraints: evidence from Mexico. Rev. Econ. Stat. 97:224–28.

Annen K, Strickland S. 2017. Global samaritans? donor election cycles and the allocation of humanitarian aid. Eur. Econ. Rev. 96:38–47.

Arendt JN, Dustmann C, Ku H. 2022. Refugee migration and the labour market: lessons from 40 years of post-arrival policies in Denmark. Oxf. Rev. Econ. Policy 38:531–56.

Asfaw S, Davis B. 2018. Can cash transfer programmes promote household resilience? cross-country evidence from Sub-Saharan Africa. In Climate Smart Agriculture: Building Resilience to Climate Change, ed. L Lipper, N McCarthy, D Zilberman, S Asfaw, G Branca, pp.227–250. Springer International Publishing

Baez J, Caruso G, Mueller V, Niu C. 2017. Droughts augment youth migration in Northern Latin America and the Caribbean. Clim. Chang. 140:423–35

Bahar D, Ib´an˜ez AM, Rozo SV. 2021. Give me your tired and your poor: impact of a large-scale amnesty program for undocumented refugees. J. Dev. Econ. 151:102652

Balana B, Adeyanju D, Clingain C, Andam KS, de Brauw A, et al. 2023. Anticipatory cash transfers for climate resilience: findings from a randomized experiment in northeast Nigeria. NSSP Work. Pap. 69, Int. Food Policy Res. Inst. https://doi.org/10.2499/p15738coll2.136812

Baseler T. 2023. Hidden income and the perceived returns to migration. Am. Econ. J.: Appl. Econ. 15:321–52.

Bastagli F, Hagen-Zanker J, Harman L, Barca V, Sturge G, et al. 2019. The impact of cash transfers: a review of the evidence from low-and middle-income countries. J. Soc. Policy 48:569–94

Batista C, McKenzie D. 2021. Testing classic theories of migration in the lab. Policy Res.Work. Pap. 9751, World Bank Group. http://documents.worldbank.org/curated/en/751311629230403942/Testing- Classic-Theories-of-Migration-in-the-Lab

Bazzi S, Cameron L, Schaner SG, Witoelar F. 2021. Information, intermediaries, and international migration. Work. Pap. 29588, Natl. Bur. Labor Stat. https://www.nber.org/papers/w29588

Beine M, Bertinelli L, Comertpay R, Litina A, Maystadt JF. 2021. A gravity analysis of refugee mobility using mobile phone data. J. Dev. Econ. 150:102618

Berlin Rubin N, Wong-Parodi G. 2022. As California burns: the psychology of wildfire-and wildfire smoke-related migration intentions. Popul. Environ. 44:15–45

Betts A, Bloom L, Kaplan J, Omata N. 2017. Refugee Economies: Forced Displacement and Development. Oxford University Press

Betts A, Chaara I, Omata N, Sterck O. 2019. Refugee economies in Uganda: what di↵erence does the self-reliance model make? Rep., Refug. Stud. Cent., Univ. Oxf., Oxford, UK

Bharti N, Tatem AJ. 2018. Fluctuations in anthropogenic nighttime lights from satellite imagery for five cities in Niger and Nigeria. Sci. Data 5:1–9.

Blair CW, Grossman G, Weinstein JM. 2022. Forced displacement and asylum policy in the developing world. Int. Organ. 76:337–378.

Bluhm R, Gassebner M, Langlotz S, Schaudt P. 2021. Fueling conflict? (de)escalation and bilateral aid. J. Appl. Econ. 36:244–61

Bousquet J, Maystadt JF. 2023. The impact of giving working rights to refugees on their hosts in Jordan. Mimeo

Bryan G, Chowdhury S, Mobarak AM. 2014. Underinvestment in a profitable technology: the case of seasonal migration in Bangladesh. Econometrica 82:1671–1748

Bustos P, Caprettini B, Ponticelli J. 2016. Agricultural productivity and structural transformation: evidence from Brazil. Am. Econ. Rev. 106:1320–65

Call MA, Gray C, Yunus M, Emch M. 2017. Disruption, not displacement: environmental variability and temporary migration in Bangladesh. Glob. Environ. Chang. 46:157–65

Caruso G, Canon CG, Mueller V. 2019. Spillover effects of the Venezuelan crisis: migration impacts in Colombia. Oxf. Econ. Papers 73:771-95

Cattaneo C, Beine M, Fröhlich CJ, Kniveton D, Martinez-Zarzoso Inmaculada, et al. 2019. Human migration in the era of climate change. Rev. Environ. Econ. Policy 13:189–206

Cattaneo C, Peri G. 2016. The migration response to increasing temperatures. J. Dev. Econ. 122:127–46

Chen J, Mueller V. 2018. Coastal climate change, soil salinity and human migration in Bangladesh. Nat. Clim. Chang. 8:981–85

Chen S, Oliva P, Zhang P. 2022. The effect of air pollution on migration: evidence from China. J. Dev. Econ. 156:102833

Chort I, de La Rupelle M. 2022. Managing the impact of climate on migration: evidence from Mexico. J. Popul. Econ. 35:1777–1819

Christian P, Barrett CB. 2017. Revisiting the effect of food aid on conflict: a methodological caution. Policy Res. Work. Pap. 8171, World Bank Dev. Res. Group. https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-8171

Clemens MA, Mendola M. 2020. Migration from developing countries: selection, in- come elasticity, and Simpson's paradox. Discuss. Pap. No. 13612, IZA Inst. La- bor Econ. https://www.iza.org/publications/dp/13612/migration-from-developing- countries-selection-income-elasticity-and-simpsons-paradox

Colmer, J. 2021. Temperature, labor reallocation, and industrial production: evidence from India. Am. Econ. J.: Appl. Econ. 13:101–24.

Cramer JC. 1998. Population growth and air quality in California. Demography 35:45–56.

Cunha JM, De Giorgi G, Jayachandra S. 2019. The price effects of cash versus in-kind transfers. Rev. Econ. Stud. 86:240–81

Dagnelie O, Mayda A, Maystadt JF. 2023. Refugees, children's health and malaria transmission in Africa. CEPR Discussion Paper No. 18284, CEPR Press. https://cepr.org/publications/dp18284

Dampha N, Salemi C, Polasky S. 2022. Rohingya refugee camps and forest loss in Cox's Bazar, Bangladesh: an inquiry using remote sensing and econometric approaches. Policy Res. Work. Pap. 9948, World Bank Group. https://doi.org/10.1596/1813-9450-9948

De Janvry A, Finan F, Sadoulet E, Vakis R. 2006. Can conditional cash transfer programs serve as safety nets in keeping children at school and from working when exposed to shocks? J. Dev. Econ. 79:349–73

Delius A, Sterck O. 202. Cash transfers and micro-enterprise performance: theory and quasi-experimental evidence from Kenya. CSAE Working Paper 2020-09, Cent. Study Afr. Econ. (CSAE), Univ. Oxf. https://ideas.repec.org/p/csa/wpaper/2020-09.html

Dionigi F, Tabasso D. 2022. Academic trends in forced displacement. U.N. High Comm. Refugees. https://www.unhcr.org/people-forced-to-flee- book/wp content/uploads/sites/137/2021/10/Filippo-Dionigi-and-Domenico- Tabasso Academic-Trends-in-Forced-Displacement.pdf

Drabo A, Mbaye LM. 2015. Natural disasters, migration and education: an empirical analysis in developing countries. Environ. Dev. Econ. 20:767–96

Egger D, Haushofer J, Miguel E, Niehaus P, Walker M. 2022. General equilibrium effects of cash transfers: experimental evidence from Kenya. Econometrica 90:2603–43

Enenkel M, Shrestha RM, Stokes E, Román M, Wang Z, et al. 2019. Emergencies do not stop at night: advanced analysis of displacement based on satellite-derived nighttime light observations IBM J. Res. Dev. 64:8:1–8:12.

Engineering and Environmental Services Section (EESS). 2002. Refugee operations and environmental management: a handbook of selected lessons learned from the field. U.N. High Comm. Refugees.

Fallah B, Krafft C, Wahba J. 2019. The impact of refugees on employment and wages in Jordan. J. Dev. Econ. 139:203-216.

Ferraro PJ, Simorangkir R. 2020. Conditional cash transfers to alleviate poverty also reduced deforestation in Indonesia. Sci. Adv. 6: eaaz1298

Filmer D, Friedman J, Kandpal E, Onishi J. 2023. Cash transfers, food prices, and nutrition impacts on ineligible children. Rev. Econ. Stat. 105:327–43

Findley MG, Powell J, Strandow D, Tanner J. 2011. The localized geography of foreign aid: a new dataset and application to violent armed conflict. World Dev. 39:1995–2009

Fitz D, League R. 2021. School, shocks, and safety nets: can conditional cash transfers protect human capital investments during rainfall shocks? J. Dev. Stud. 57:2002–26

Freire S, Aubrecht C, Wegscheider S. 2013. Advancing tsunami risk assessment by improving spatio- temporal population exposure and evacuation modeling. Nat. Hazards 68:1311–24

Gazeaud J, Mvukiyehe E, Sterck O. 2023. Cash transfers and migration: theory and evidence from a randomized controlled trial. Rev. Econ. Stat.

Goldammer JG, Stocks BJ. 2011. Migration and global environmental change. Special Rep. No. 10, Govt. Office for Science, United Kingdom.

Gray C, Mueller V. 2012. Drought and population mobility in rural Ethiopia. World Dev. 40:134–45 Gray, CL. 2011. Soil quality and human migration in Kenya and Uganda. Glob. Environ. Chang. 21:421–30

Gröger A, Zylberberg Y. 2016. Internal labor migration as a shock coping strategy: evidence from a typhoon. Am. Econ. J.: Appl. Econ. 8:123–53

Handa S, Natali L, Seidenfeld D, Tembo G, Davis B. 2018. Can unconditional cash transfers raise long-term living standards? evidence from Zambia. J. Dev. Econ. 133:42–65

Harris JR, Todaro M. 1970. Migration, unemployment and development: a two-sector analysis. Am. Econ. Rev. 60:126-42

Heft-Neal S, Burney J, Bendavid E, Burke M. 2018. Robust relationship between air quality and infant mortality in Africa. Nature 559:254–258.

Hidrobo M, Hoddinott J, Peterman A, Margolies A, Moreira V. 2014. Cash, food, or vouchers? evidence from a randomized experiment in northern Ecuador. J. Dev. Econ. 107:144–56

Hidrobo M, Mueller V, Roy S. 2022. Cash transfers, migration, and gender norms. Am. J. Agric. Econ. 104:550–68

Hoddinott J, Mekasha TJ. 2020. Social protection, household size, and its determinants: evidence from Ethiopia. J. Dev. Stud. 56:1818–37

Hoffmann R, Sédová B, Vinke K. 2021. Improving the evidence base: a methodological review of the quantitative climate migration literature. Glob. Environ. Chang. 71:102367.

Huckstep S, Clemens M. 2023. Climate change and migration: an omnibus overview for policymakers and development practitioners. Policy Pap. 292, Cent. Glob. Dev. https://www.cgdev.org/publication/climate-change-and-migration-omnibus- overview-policymakers-and-development

Hunter LM, Luna JK, Norton RM. 2015. Environmental dimensions of migration. Annu. Rev. Sociol. 41:377–97

Ibáñez AM, Moya A, Ortega M, Rozo SV, Urbina M. 2022. Life out of the shadows: the impacts of regularisation programs on the lives of forced migrants. Policy Res. Work. Pap. 9928, World Bank Dev. Res. Group. http://hdl.handle.net/10986/36967

Ibáñez AM, Rozo SV. 2020. Forced migration and the spread of infectious diseases. UC Berkeley: Cent. E↵. Glob. Action. https://doi.org/10.26085/C3KS3M

Jaafar H, Ahmad F, Holtmeier L, King-Okumu C. 2020. Refugees, water balance, and water stress: lessons learned from Lebanon. Ambio 49:1179–93

Jagnani M, Barrett CB, Liu Y, You L. 2021. Within-season producer response to warmer temper- atures: defensive investments by Kenyan farmers. Econ. J. 131:392–419

Jessoe K, Manning DT, Taylor JE. 2018. Climate change and labour allocation in rural Mexico: evidence from annual fluctuations in weather. Econ. J. 128:230–61

Kadigo M, Maystadt JF. 2023. How to cope with a refugee shock? evidence from Uganda. World Dev. Forthcoming.

Kayaoglu A. 2022. Do refugees cause crime? World Dev. 154:105858

Khanna G, Liang W, Mobarak AM, Song R. 2021. The productivity consequences of pollution-induced migration in China. Work. Pap. 28401, Natl. Bur. Econ. Res.

Kleemans M. 2023. Migration choice under risk and liquidity constraints. Work. Pap. https://drive.google.com/file/d/1VW6 CPSWm2pMRKtMZP5zEpu9PTiTM- Vh/view

Kugler TA, Grace K, Wrathall DJ, de Sherbinin A, Van Riper D, et al. 2019. People and pixels 20 years later: the current data landscape and research trends blending population and environ-mental data. Popul. Environ. 41:209–34

Liu M, Shamdasani Y, Taraz V. 2023. Climate change and labor reallocation: evidence from six decades of the Indian Census. Am. Econ. J.: Econ. Policy 15:395–423.

Lu X, Wrathall DJ, Sundsøy PR, Nadiruzzaman M, Wetter E, et al. 2016. Unveiling hidden migration and mobility patterns in climate stressed regions: a longitudinal study of six million anonymous mobile phone users in Bangladesh. Glob. Environ. Chang. 38:1–7

Lybbert TJ, Barrett CB, Desta S, Coppock, DL. 2004. Stochastic wealth dynamics and risk management among a poor population. Econ. J. 114:750–77

Ma G, Hofman ET. 2019. Immigration and environment in the U.S.: a spatial study of air quality. Soc. Sci. J. 56:94–106

Mach K, Kraan C, Adger N, Buhaug H, Burke M. 2019. Climate as a risk factor for armed conflict. Nature 571:193-97

Macours K, Premand P, Vakis R. 2022. Transfers, diversification and household risk strategies: can productive safety nets help households manage climatic variability? Econ. J. 132:2438–70

MacPherson C, Sterck O. 2021. Empowering refugees through cash and agriculture: a regression discontinuity design. J. Dev. Econ. 149:102614

Mahajan P, Yang D. 2020. Taken by storm: hurricanes, migrant networks, and US immigration. Am. Econ. J.: Appl. Econ. 12:250–77

Marchiori L, Maystadt JF, Schumacher I. 2012. The impact of weather anomalies on migration in sub-Saharan Africa. J. Environ. Econ. Manag. 63:355–74

Martínez Flores F, Milusheva S, Arndt RR. 2021. Climate anomalies and interna- tional migration: a disaggregated analysis for West Africa. Ruhr Econ. Pap. 910. https://ideas.repec.org/p/zbw/rwirep/910.html

Mary S, Mishra AK. 2020. Humanitarian food aid and civil conflict. World Dev. 126:104713.

Massey DS, Arango J, Hugo G, Kouaouci A, Pellegrino A, et al. 1993. Theories of international migration: a review and appraisal. Popul. Dev. Rev. 19:431–66

Maystadt JF, Hirvonen K, Mabiso Athur, Vandercasteelen J. 2019. Impacts of hosting forced migrants in poor countries. Annu. Rev. Resour. Econ. 11:439–59

Maystadt JF, Mueller V, Van Den Hoek J, van Weezel S. 2020. Vegetation changes attributable to refugees in Africa coincide with agricultural deforestation. Environ. Res. Lett. 15:044008

Maystadt JF, Verwimp P. 2014. Winners and losers among a refugee-hosting population. Econ. Dev. Cult. Chang. 62:769–809

Meghir C, Mobarak AM, Mommaerts C, Morten M. Migration and informal insurance: evidence from a randomized controlled trial and a structural model. Rev. Econ. Stud. 89:452–80.

Milliff A, Christia F. 2023. Who flees conflict? a big-data approach to the deter- minants of forced migration. https://aidanmilliff.com/publication/who-flees-big-data-migration/WhoFlees.pdf

Missirian A, Schlenker W. 2017. Asylum applications respond to temperature fluctuations. Science 358:1610–14

Mueller V, Gray C, Handa S, Seidenfeld D. 2020a. Do social protection programs foster short-term and long-term migration adaptation strategies? Environ. Dev. Econ. 25:135–58

Mueller V, Gray C, Hopping D. 2020b. Climate-induced migration and unemployment in middle- income Africa. Glob. Environ. Chang. 65:102183

Mueller V, Gray C, Kosec K. 2014a. Heat stress increases long-term human migration in rural Pakistan. Nat. Clim. Chang. 4:182–85

Mueller V, Quisumbing A, Lee HL, Droppelmann K. 2014b. Resettlement for food security's sake: insights from a Malawi land reform project. Land Econ. 90:222–36

Mueller V, Sheriff G, Dou X, Gray C. 2017. Labor response to climate variation in Eastern Africa. Paper presented at the Center for Environmental Economics and Sustainability Policy Seminar. Mueller V, Sheriff G, Dou X, Gray C. 2020c. Temporary migration and climate variation in Eastern Africa. World Dev. 126:104704

Munshi K. 2003. Networks in the modern economy: Mexican migrants in the US labor market. Q. J. Econ. 118:549–99

Neef K, Jones E, Marlowe J. 2023. The conflict, climate change, and displacement nexus revisited: the protracted Rohingya refugee crisis in Bangladesh. J. Peacebuilding Dev.

Nelson A, Chomitz KM. 2011. Effectiveness of strict vs. multiple use protected areas in reducing tropical forest fires: a global analysis using matching methods. PLoS ONE 6:e22722

Nobre GG, Davenport F, Bischiniotis K, Veldkamp T, Jongman B, et al. 2019. Financing agricultural drought risk through ex-ante cash transfers. Sci. Total Environ. 653:523–35

Nunn N, Qian N. 2014. US food aid and civil conflict. Am. Econ. Rev. 104:1630–66

Owen M, Kruczkiewicz A, Van Den Hoek J. 2023. Indexing climatic and environmental exposure of refugee camps with a case study in East Africa Sci. Rep. 13:1–14

Özler B, Çelik C, Cunningham S, Cuevas PF, Parisotto L. 2021. Children on the move: progressive redistribution of humanitarian cash transfers among refugees. J. Dev. Econ. 153:102733

Peralta A, Scott JB. 2023 Does the national flood insurance program drive migration to higher risk areas? J. Assoc. Environ. Resour. Econ. Forthcoming

Pérez-Peña R. 2023. Five deaths at sea gripped the world. hundreds of others got a shrug. New York Times, Jun. 23, online

Peters K, Dewulf AL, Barbelet V, Benoudji C, Le Masson V. 2019. Pursuing disaster risk reduction on fractured foundations: the case of Chad. Res. rep., Overseas Dev. Inst., London, UK

Peters, LER. 2021. Beyond disaster vulnerabilities: an empirical investigation of the causal pathways linking conflict to disaster risks. Int. J. Disaster Risk Reduct. 55:102092

Price CE, Feldmeyer B. 2012. The environmental impact of immigration: an analysis of the effects of immigrant concentration on air pollution levels. Popul. Res. Policy Rev. 31:119–40

Proctor J, Carleton T, Sum S. 2023. Parameter recovery using remotely sensed variables. Work. Pap. 30861, Natl. Bur. Econ. Res. https://www.nber.org/papers/w30861

Quiñones EJ, Nobles Jenna, Riosmena F, Nawrotzki R. 2023. Anticipatory migration responses to rural climate shocks AEA Pap. Proc. 113: 367–71

Reilley R, Flynn M. 2022. The Ukraine crisis. double standards: has Europe's response to refugees changed? Global Detention Project, Mar. 2

Ronald, MA. 2020. An assessment of economic and environmental impacts of refugees in Nakivale, Uganda. Migr. Dev. 11: 433-49

Rosenzweig MR, Stark O. 1989. Consumption smoothing, migration, and marriage: evidence from rural India. J. Political Econ. 97:905–26

Salemi C. 2021. Refugee camps and deforestation in Sub-Saharan Africa. J. Dev. Econ. 152:102682

Salti N, Chaaban J, Moussa W, Irani A, Al Mokdad R, et al. 2022. The impact of cash transfers on Syrian refugees in Lebanon: evidence from a multidimensional regression discontinuity design. J. Dev. Econ. 155:102803

Schewel K. 2020. Understanding immobility: moving beyond the mobility bias in migration studies. Int. Migr. Rev. 54:328–55

Scoones I. 1998. Sustainable rural livelihoods: a framework for analysis. Work. Pap. 72, Inst. Dev. Stud.

Senande-Rivera M, Insua-Costa D, Miguez-Macho G. 2022. Spatial and temporal expansion of global wildland fire activity in response to climate change. Nat. Commun. 13:1208

Squalli J. 2010. An empirical assessment of U.S. state-level immigration and environmental emissions. Ecol. Econ. 69:1170–75

Stark O, Bloom DE. 1985. The new economics of labor migration. Am. Econ. Rev. 75:173–78
Stecklov G, Winters P, Stampini M, Davis B. 2005. Do conditional cash transfers influence migration? a study using experimental data from the Mexican PROGRESA program. Demography 42:769–90

Taylor JE, Martin PL. 2001. Human capital: migration and rural population change. In Handbook of Agricultural Economics, Vols. 1, ed. B. Gardner and G. Rausser, pp. 457–511. Amsterdam: Elsevier.

Tumen S. 2016. The economic impact of Syrian refugees on host countries: quasi-experimental evidence from Turkey. Am. Econ. Rev. 106:456–60

UNHCR. 2022. Global trends: forced displacement in 2022 Glob. Trends Rep. 2022, U.N. High Comm. Refugees.

U.N. High Comm. Refugees. 2023. Refugee data finder. https://www.unhcr.org/refugee-statistics/download/?url=r14JPM

U.S. Agency for International Development (USAID). 2022. International food assistance report: fiscal year 2021 report to Congress.

Van Den Hoek, J, Murillo-Sandoval P, Crumley RL, Devenish A, Fein F, et al. 2018. Refugee camps as climate traps: measuring the enviro-climatic marginality of 922 global refugee camps with satellite time series data. Am. Geophys. Union, Fall meeting (Abstr.)

Verme P, Schuettler K. 2021. The impact of forced displacement on host communities: a review of the empirical literature in economics. J. Dev. Econ. 50:102606

Verwimp P, Maystadt JF. 2015. Forced displacement and refugees in Sub-Saharan African economic inquiry. Policy Res. Work. Pap. 7517, World Bank Group. https://openknowledge.worldbank.org/entities/publication/d36e0f44-7f6a-59cf- 9d1a-06cbcd943ee1

Wan C, Roy SS. 2023. Geospatial characteristics of fire occurrences in southern hemispheric Africa and Madagascar during 2001–2020. J. For. Res. 34:553–63

Winkler RL, Rouleau MD. 2021. Amenities or disamenities? estimating the impacts of extreme heat and wildfire on domestic US migration. Popul. Environ. 42:622–48

Wood RM, Sullivan C. 2015. Doing harm by doing good? the negative externalities of humanitarian aid provision during civil conflict. J. Politics 77:736–48

World Bank. 2023a. Labor market impacts of forced displacement jobs in host communities in Colombia, Ethiopia, Jordan, and Uganda. Forthcoming. World Bank, Washington, DC

World Bank. 2023b. World development report 2023: migrants, refugees, and societies. World Bank, Washington, DC

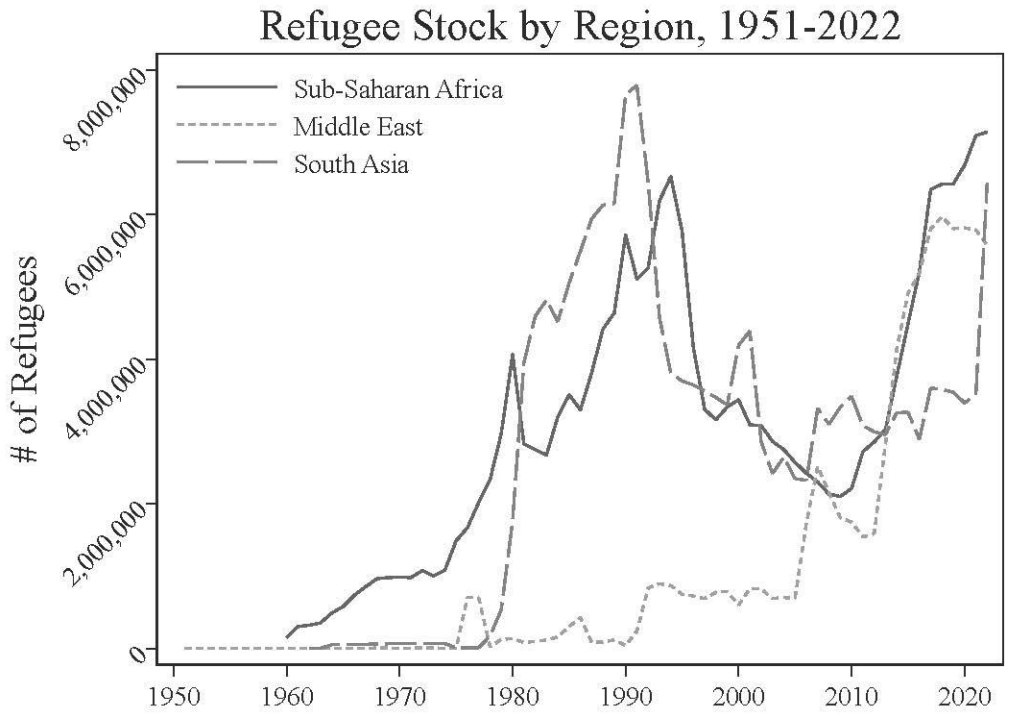
Wreikat MA, Al Kharabsheh AA. 2020. Impact of over-pumping on groundwater resources sustain- ability at Amman Zarqa basin, Jordan: a case study of arid areas affected by Syrian refugee crisis Environ. Earth Sci. 79

Zhao Z, Li W, Ciais P, Santoro M, Cartus O, et al. 2021. Fire enhances forest degradation within forest edge zones in Africa. Nat. Geosci. 14:479–83

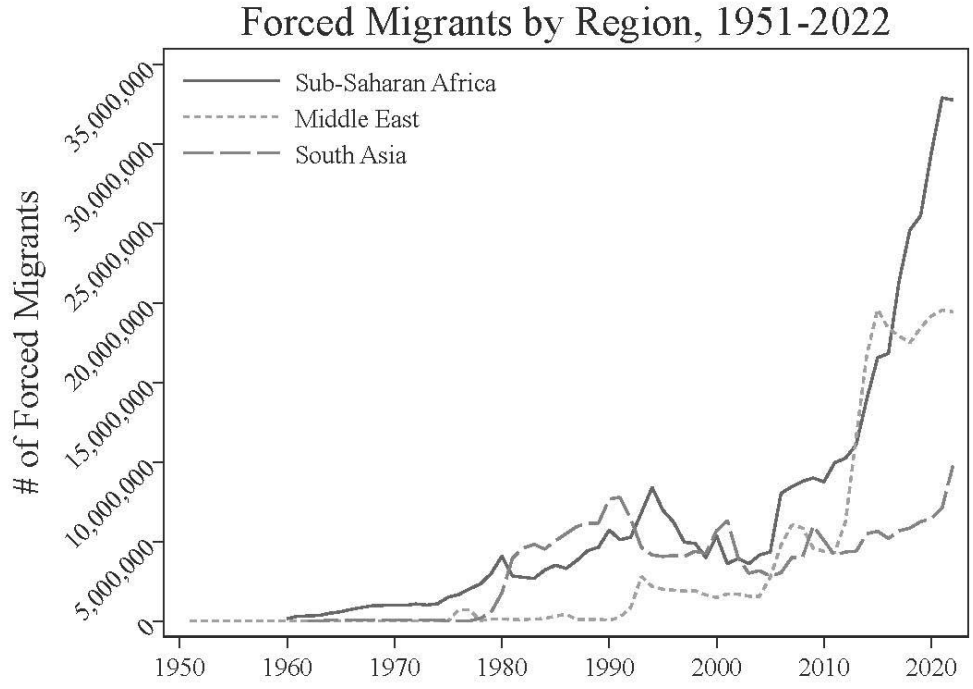
Zhu H, Gupta A, Filipski M, Valli J, Gonzalez-Estrada E, et al. 2023. Economic impact of giving land to refugees. Am. J. Agric. Econ.

Figure 1. Refugee and Forced Migrant Stock by Region, 1951-2022

Panel A



Panel B

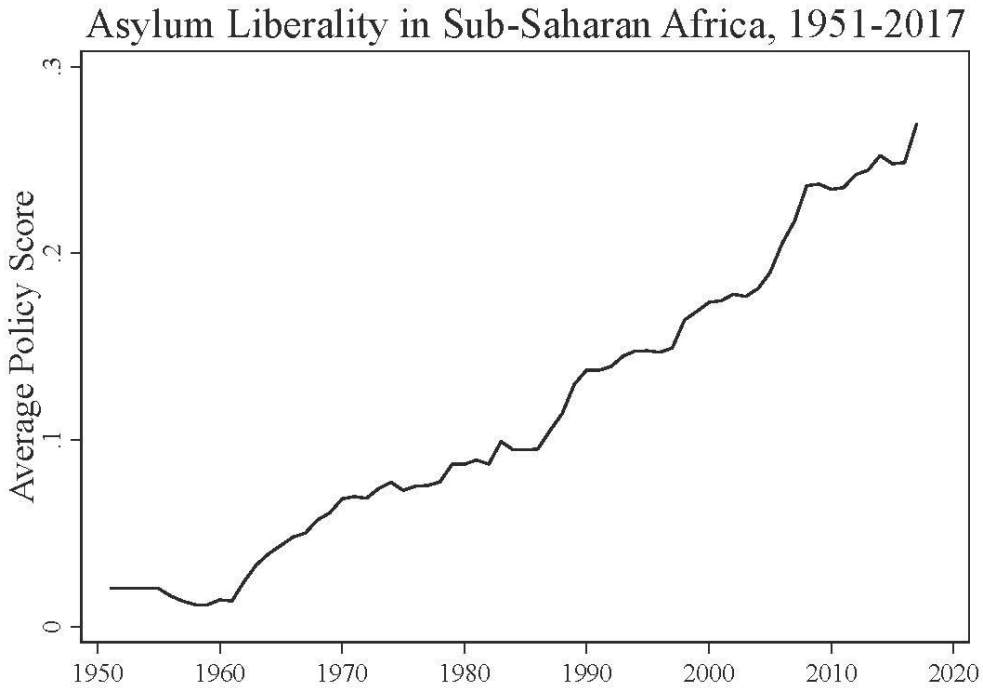


Note: Panel A plots the total refugee stock by region between 1951 and 2022. Panel B plots the total forced migrant stock by region between 1951 and 2022. According to the former, Africa and South Asia contain the largest refugee stocks. According to the latter, Africa contains the largest share of forced migrants for a majority of the given time period.

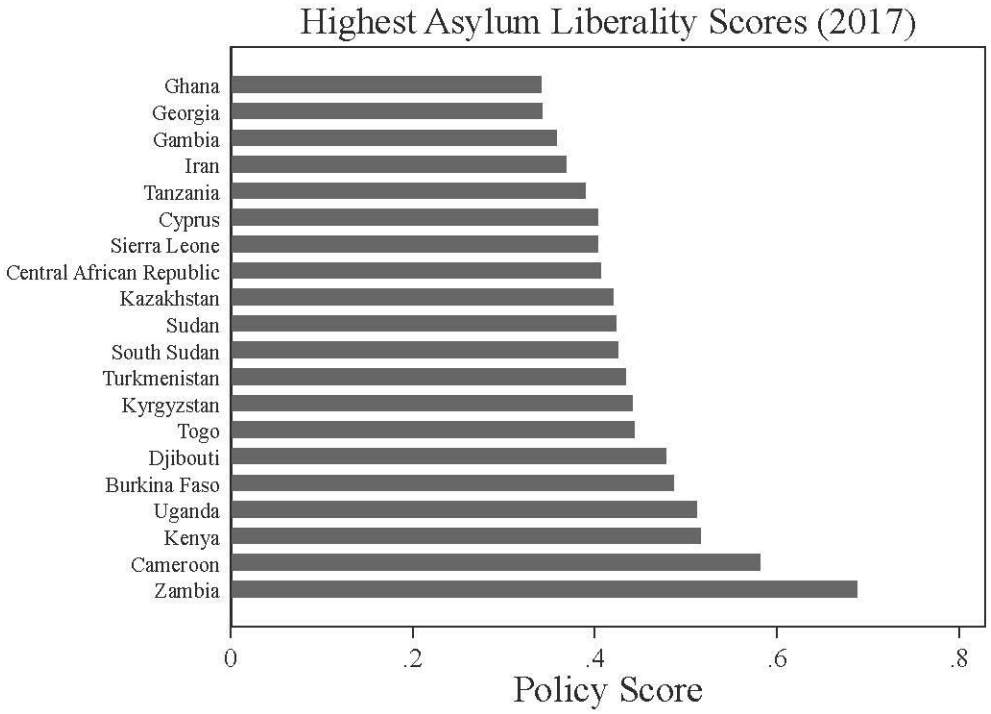
Source: Authors' calculations using data come from the UNHCR (2023). Regions defined using typology in Blair et al. (2022).

Figure 2: Asylum Liberality over Time

Panel A



Panel B



Note: Panel A reflects the average liberality of asylum policies in Sub-Saharan Africa between 1951 and 2017. Panel B reflects the twenty countries with the highest asylum liberality in 2017.

Source: Authors' calculations using data from Blair et al. (2022).

Table 1: Examples of Mechanisms Examines in Environmental Migration Literature

Environmental Factor	Study	Mechanism underlying migration response	Migration constraints or enabling factors	Summary of findings
Heat stress	Mueller et al. (2020c)	Reduced yields from heat stress induce household members to diversify income by migrating for work.	Labor markets not situated to accommodate excess rural labor.	They evaluate the impact of temperature anomalies on temporary migration in rural and urban areas of Ethiopia, Malawi, Uganda, and Tanzania. They find that there is no impact of temperature on temporary migration in rural areas, but temperature variability deters temporary migration in urban areas. Negative temperature response to non-farm employment used to illustrate the importance of labor demand in influencing migration adaptation strategies.
	Mueller et al. (2020a)		Financial capital is needed to support moving for work when the climate is favorable.	They evaluate the impact of temperature anomalies on short- and long-distance moves in the context of a cash transfer program to understand whether financial capital is the binding constraint on adaptation. Cash transfers accelerate short-distance moves amidst cooler temperatures presumably when demand for work in nearby farms is secure. Men are less likely to move (short or long distance) during extreme hot temperatures and there is no additional migration effect that occurs when receiving the cash transfer.
	Mueller et al. (2020b)		Temperature increases demand for on-farm labor for weeding, pesticide, and fertilizer applications, which increases the opportunity cost of off-farm work.	They evaluate the impact of temperature anomalies on migration and employment outcomes in Botswana, Kenya, and Zambia. Temperature variability reduced the odds of moving in Botswana, but not in other countries. The migration effects may have been limited in Zambia because the demand for labor amid temperature shocks likely rises. For example, the probability of being inactive and unemployed declined 28 and 36 percent respectively with a one-standard deviation increase in temperature.
Storms	Gröger & Zylberberg (2016)	Households encourage members to migrate long distances so that remittances may be used to compensate for agricultural income losses.	Storm exposure is widespread making adjacent labor markets equally vulnerable, which reduces the location choice set for migrants to distant destinations.	They evaluate the impact of Typhoon Ketsana on the migration, remittances, and income of households in Vietnam. Income-smoothing comes from households either receiving transfers from satellite household members or sending current household members to urban areas to earn remittances. There are no transfers received from satellite household members who reside in the same district as the household. This suggests a limitation in using migration to adapt to storms either due to the lack of immunity from exposure or the return to migration being lower reducing the capacity of migrants to remit.
	Mahajan & Yang (2020)		Migrant networks at the origin reduce the costs and uncertainty of moving amplifying the effect of hurricanes on long-distance migration	They evaluate the impact of hurricanes on migration to the United States. They find that hurricanes increase migration by 11.8 percent relative to the mean annual migration rate. They also show that existing migrant networks amplify the effect by reducing the costs of migrating internationally.

Drought	Gray & Mueller (2012)	Drought affects rural livelihoods and induces young and male household members to migrate for work as the opportunity cost of their farm labor is lower.	Norms regarding the intrahousehold allocation of labor inform who migrates, as women are less likely to move for marriage-related reasons due to drought	They evaluate the impact of drought on migration distinguishing effects by the type of move, the motivation for the move, and heterogeneous characteristics at the individual and household level. They find that men tend to move amid a drought to work especially when from an asset-poor household, while women who mainly move for marriage are less likely to move. This may be driven by the increased demand for domestic and agricultural work as members leave the home or be indicative of droughts' impact on marriage markets.
	Baez et al. (2017)		Healthy labor markets foster the use of migra- tion as an adaptation strategy. Development assistance reduces distress migration.	They evaluate the impact of drought intensity on the migration of youth in Northern Latin America and the Caribbean. Increasing the exposure to drought by one standard deviation results in a 116 percent increase in migration. They evaluate the role of labor market structure and access to credit as mediating or enabling factors. Wealthier countries (measured by GDP per capita) experience higher rates of drought-affected migration, as their labor markets are likely to absorb the excess supply of labor. Development assistance dampens the tendency of youth to migrate in response to droughts perhaps due to the level of targeting in drought-prone areas.
Gradual change in temperature	Liu et al. (2023)	Rural-urban migration declines due to the impact of temperature on the demand for migrant labor.	Consumers experience income losses amid changes in temperature, which affects the de- mand for goods and services. Declines in market demand cause a subsequent negative effect on the demand for migrant workers in the ser- vice sector.	They evaluate how gradual changes in temperature affect rural-urban migration patterns in India. Long-term changes in temperature during the growing season inhibit migration and reallocate workers away from the non-agricultural sector.
	Quiñones et al. (2023)	Farmers send migrants after observing crop losses experienced by their neighbors to mitigate risk ex ante.	Farmers use migration to cope with both ex ante and ex post risk, but preemptive moves via ex ante migration largely remain within country. Riverine flooding only temporarily disrupts	They evaluate the impact of temperature-related ex ante and ex post income risk on domestic and international migration in Mexico. Engagement in ex ante migration is relatively smaller, representing one-third of climate-induced migration. Ex ante domestic migration rises 60 to 66 percent relative to the mean migration rate with cumulative exposure to crop losses experienced by one's neighbors.

Riverine or coastal flooding	Call et al. (2017)	Flooding can cause displacement through the inundation of infrastructure and delaying the onset of the growing season.	Riverine flooding only temporarily disrupts livelihoods leading to little effect on migration.	The authors explore the relationship between migration and a multitude of environmental factors using data collected in Bangladesh. Riverine flooding only displaces households temporarily. Other factors such as temperature and precipitation anomalies have more long-lasting effects on migration because they have more permanent effects on agricultural income and formal and informal institutions to insure households against risk are lacking.
	Peralta & Scott (2023)	Anticipated infrastructural damage from flooding discourages residential investments in vulnerable locations.	Flood insurance programs reduce liability of flooding on infrastructure damage reducing incentives to migrate out of low elevation coastal zones.	The authors focus on measuring the impact of the National Flood Insurance Program (NFIP) on migration into flood-prone areas in the U.S. The authors find that NFIP increased the population by 5 percent with each one standard deviation increase in historical flood risk. The findings offer lessons for countries in the Global South where the existence of humanitarian and social assistance programs targeting vulnerable locations may disincentives households to adapt.
Soil erosion	Gray (2011)	Migration responses depend on the productive potential of the farm.	Soil health contributes to the natural capital on the farm that determines its productive potential.	The author uses information about the soil property of agricultural parcels to build an index of soil quality in Kenya and Uganda. He then examines how different forms of migration respond to soil quality. He finds that such natural capital deters people from migrating for work temporarily in Kenya but encourages permanent migration for alternative purposes in Uganda.
	Chen & Mueller (2018)		Soil salinity from coastal flooding drives intra-district migration due to the consequences on the ability to farm.	The authors analyze migration and income data combined with remote sensing data on flooding, in situ salinity data, and weather and satellite data to capture other dimensions of climate. They find soil salinity (rather than inundation from flooding) drives income losses encouraging people to move within the district. Migration across districts increases but to a much lower degree. International migration diminishes with soil salinity perhaps due to the tradeoffs being made between investments in saline-tolerant production processes (such as shrimp aquaculture) and earning opportunities abroad.
Air quality	Khanna et al. (2021)	Residential choice will depend on the amenity value of air quality.	Skilled workers assign a higher amenity value to air quality and therefore migrate out of cities with poor air quality at a faster rate than unskilled workers.	The authors analyze multiple sources of migration and air quality data to examine the relationship between air quality amenities and location choice in China. The authors find that poor air quality encourages workers to relocate, but the response rates are greater among skilled relative to unskilled workers. The authors use structural modeling to predict the productivity losses from the resorting of workers with different skill sets.
	Chen et al. (2022)		Skilled workers and women have the greatest migratory responses which may reflect distinctions in the	The authors use socioeconomic and air pollution data to discern migratory responses to air quality. They find that a ten percent increase in PM2.5 reduces net outflows by 2.8 per 100 people. The authors find start differences in education, gender, and age group. Consistent with the literature, the educated bear greater migratory responses to air pollution. Women have a greater tendency to move than men perhaps because of the benefits of

			perceived benefits of the amenity.	splitting the household to preserve the health of children. Finally, young men entering the labor force are less likely to move in response to air quality indicative of the costs of moving varying by work experience.

Source: Authors' compilation.

Table 2: Examples of Refugee and Environmental Degradation Literature.

Environmental Outcome	Study	Mechanism	Summary of Findings
Deforestation	Maystadt et al. (2020)	Conversion of forest to cropland	The authors investigate the effect of refugee encampments on the conversion of forest to cropland in 49 African countries between 2000 and 2016. They find the number of refugees exerts a positive effect on the expansion of agriculture. Thus, refugees contribute to environmental degradation through the conversion of forests to cropland.
	Salemi (2021)	Extraction of firewood	The author studies the effect of planned refugee encampments on land clearing and forest canopy cover in the rainforest and grassland biomes of 35 sub-Saharan African countries between 2001 and 2012. The results indicate encampments reduce land clearing yet increase the loss of canopy cover in nearby (i.e., within 20 km) rainforests. Encampments also reduce canopy cover in nearby grasslands. Her emphasis on firewood extraction implicates it as the most likely explanation.
	Dampha et al. (2022)	Conversion of forest to settlement	The authors investigate the effect of the 2017 influx of Rohingya refugees on forest cover in the Cox Bazar district of Bangladesh. The results suggest the influx of refugees significantly decreased forest cover – and increased settled land – in the Cox Bazar district, especially within refugee camps. Additional analysis reveals refugees' demand for construction materials and firewood contributed to deforestation within 1 km of camps, whereas market incentives drew natives to encampments, which contributed to deforestation between 1 km and 5 km.
Water Depletion	Jaafar et al. (2020)	Population pressure	The authors estimate the degree of water stress on the Lebanese water system due to the Syrian refugee crisis. They find the refugee crisis increased demand for water and, in turn, stress on available water resources, especially in suburban areas.
	Wreikat & Kharabsheh (2020)		The authors use governmental data and GIS mapping to assess trends in the groundwater level of the Amman Zarqa Basin prior to 2005 through 2017. Across seven sites, they found declining groundwater levels, especially in the western portion of the study area, which contains the Zaatari refugee camp. The authors attribute declining groundwater levels to over-pumping.
Water Contamination	Al-Harahsheh et al. (2015)	Waste disposal	The authors investigate the water quality in and around the Za'atari refugee camp of Jordan. Ground- water and surface water samples reflect contamination from human activities such as the disposal of human, solid, and chemical (including medical and fuel) waste.
Air pollution	Alshirah et al. (2021)	General consumption	The authors conduct field studies of air, water, and soil quality in the Zaatari refugee camp of Jordan. They find evidence of air, water, and soil contamination, especially in the most populated section of the camp. The authors attribute air pollution to human activity, such as emissions from automobiles.

Source: Authors' compilation.