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Environmental migration and cities in the context of global environmental change

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There is a renewed interest in environmental migration and displacement that is fueled by concerns about the impacts of global environmental change on human populations. Regardless on-going debates about magnitudes and definitions, recent research on the topic shows a complex picture where environmental events are rarely the only drivers, several factors — among them the characteristics of the event and the degree of vulnerability — influence the outcome, and different types of mobility can be distinguished. Within this framework and in the context of global processes, research on the interactions among cities, environmental migration and GEC present two interrelated perspectives. On the one hand, cities are increasingly exposed to the impacts of GEC events, which can trigger environmental migration to other regions. On the other hand, they are the most common destinations of migration inflows, and environmental change outside of cities can exacerbate the influx of migrants to cities. The case of New Orleans and Hurricane Katrina dramatically illustrates these issues, highlighting the policy and governance dimensions.

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Introduction

Population mobility is a common strategic response for adapting to and coping with environmental risk, stress and hardship [1••]. Today, concerns about the consequences of global environmental change (GEC) for human well-being and population mobility [2,3]; the debate about migration as a viable adaptation strategy [4••]; the idea that environmental displacement has the potential for triggering governance and security challenges [5]; and new empirical results [6•] have led to a renewed interest in the topic.

This reemergence of environmental migration in the research agenda is framed in a global context [4••], where rapid urbanization and high population mobility are reshaping population distribution and its ecological footprint [3]. These worldwide processes, together with the globalization of markets and communications, increase the interconnectedness of people and places and transform the geography of place-based vulnerability and risk [7,8].[1]

Within migration systems (defined here as two or more places connected by flows and counterflows of people [9, p. 50]), global climate change could directly and indirectly affect movements through the intensification of natural disasters, changes in water availability, rising sea levels, and general scarcity of natural resources [1••, p. 15]. From the perspective of system dynamics, both human settlements and population flows are likely to be impacted, and these effects are interrelated. GEC impacts in urban areas are likely to trigger migration and displacement. New Orleans massive evacuation after Hurricane Katrina has become the leading example, and it is developed later in this paper. Similarly, GEC impacts outside of urban areas can modify migration flows into cities. For example, worsening floods in the Mekong Delta have contributed to increase rural displacement and seasonal mobility to urban centers, notably Phnom Penh and Ho Chi Minh City [6•]. To complete the circle, migration into cities increases risk exposure (particularly among newcomers) [10], and secondary migration — that is, displacement of migrants — is a probable scenario. For example, the loss of lives due to cyclones and surge storms impacting large cities on the east coast of India is expected to rise because of increasing rural–urban migration to the coast in recent years [11].

Within this framework, this review examines recent research advances in environmental migration and cities

[1] Adger *et al.* [7, pp. 151–152] describe three main mechanisms interconnecting the vulnerabilities of ecosystems, people and places: (a) the linked processes (physical, biological and social) that make global environmental change; (b) accelerated market interactions; and (c) greater interconnectedness because of the lower transportation costs enabling greater movement of people and material resources. On the same topic, Sanderson [8, p. 99] argues that "the globalization of trade, investment and production has integrated most of the world's population and natural resources into a single, global political–economic context".

in the context of GEC. It is structured as follows: after a brief introduction to environmental migration, the paper examines the links between human settlements, environmental migration flows and GEC impacts; then, it presents the case of the city of New Orleans and Hurricane Katrina, to conclude with a policy note and some suggestions for future work.

A brief overview of environmental migration

The International Organization for Migration (IOM) defines environmental migrants as ''persons or group of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad'' [1••, p. 19]. This definition attempts to facilitate the identification of environmental migrants and to discourage the use of the term ''environmental refugees''. This term is considered legally nonbinding [6•] and has been increasingly questioned on the basis that it leads to a reductionist view of the complexity of real-life situations [4]. In addition, affected people may not want to be identified as refugees because of the implicit hopelessness and defenselessness of the term [12]. However, this debate is still ongoing (e.g. [13,14]).

Multiple factors influence migration decisions [15,16]: individual characteristics (age, gender, educational attainment, etc.) [17], household strategies [18], socioeconomic and institutional contexts [6•,19], and culture [10,20]. Environmental factors are simply another driver, and it is difficult to disaggregate their impacts from the rest of the processes affecting migration. While there is generalized agreement that environmental factors affect mobility, there is only modest consensus about the mechanisms at work and the character and extent of that contribution (see for example [1••,8,21]).

Data availability has been pointed out as ''one of the primary challenges to measure the migration and environment nexus'' [1••, p. 19]. One of the advances in the field has been the increasing (albeit insufficient) availability of more and better data through the improvement of traditional sources (population censuses [22]; inter-country and regional data collection efforts [6•,23]; and specialized surveys in case studies (e.g. [17,24,25])) and the use of novel sources, for example remote sensing [16]. These growing availability of data is linked to methodological choices, with an increased use of statistical modeling (e.g. [24]) and the incorporation of GIS and spatial analysis (e.g. [17]).

Although conclusive results are still limited, there has certainly been progress in our understanding as research findings become available. First, it is relevant to consider that environmental migration is heterogeneous, including a continuum of ''categories'' from forced to voluntary mobility according to the degrees of control over the situation and people's vulnerability: refugee-like situations (no control and high vulnerability) and migrant-like situations (in control and low vulnerability) would be located at both ends of the spectrum [1••].

Second, the characteristics of the event (its nature, magnitude, duration and timing), the type and degree of vulnerability of populations and communities at risk, and the type of assistance available for the affected population are considered key predictors of environmental migration and displacement [19,21]. Sea level rise, extreme weather events (e.g. heat waves and storms) and changes in water availability (e.g. droughts) are the climate change events more likely to impact population mobility [4••].

Finally, voluntary or mandatory evacuation is a common response to natural disasters. Some evacuees may choose to return, others may prefer to relocate somewhere else, and in some cases entire communities are re-located [26]. Mobility in response to either sudden or slow-onset events is likely to be internal (i.e. within the boundaries of a given country), short-distance and short-term [1••], although migration to nearby countries has also been documented [27]. In the case of recurrent events, long-term or circular labor mobility is often part of households' livelihood strategies [4••], particularly in rural areas of developing countries [18,19].

Human settlements and environmental migration in the context of GEC

Recent research on the interactions among environmental migration, human settlements, and GEC starts from two different perspectives:

(a) Cities are increasingly exposed to the impacts of GEC events, which can trigger environmental migration to other regions. A large proportion of urban expansion is taking place in areas exposed to environmental hazards, e.g., low lying plains, coastal zones, stepped slopes and drylands [28,29]. For example, coastal zones represent 2% of the total land but house 14% of the total world population and 23% of the total urban population, 18% in the low elevation coastal zone (LECZ, the area between the tidal line and 10 m above sea level) and frequently in agglomerations of 1 million inhabitants and more [28,30, p. 22]. Large cities in low- and middle-income countries (e.g. Alexandria, Dhaka, Buenos Aires, Lagos, Rio de Janeiro, and Shanghai) located on coastal plains are vulnerable to sea level rise (SLR) [18,31,32]. In the United States, coastal populations have increased 28% between 1980 and 2003 despite the higher risk of storms and floods in these areas [10, p. 1096].

Drylands (arid, semiarid and dry sub-humid areas) represent around 48% of the total land, and house a population estimated in about 2.5 billion people or

38% of the world population [33]. Urban populations in drylands are expected to increase from 967 million people (45%) in 2000 to 1590 million (55%) in 2025 [28]. Examples of large cities in drylands include Mexico City and El Cairo. Drought is a recurrent risk likely to increase with GEC, although predictions about water availability for individual cities carry low confidence [31].

Urban flooding is frequently linked to poor or inexistent planning. Urban sprawl into unsuited areas is credited with the disastrous consequences of flooding of the city of Santa Fe, Argentina, in 2003 and 2006 [32], and the city of Mombasa, Kenya, in 2006 [34]. In the case of Santa Fe, the city expanded on the flood plain of the Salado River, while in Mombasa poor drainage, growing slums and illegal expansion were at fault. The catastrophic floods in Mumbai, India, in 2005 were caused by an extreme weather event, but the consequences were aggravated by the combination of poor preparedness, vulnerability of poor populations and institutional failure [11, p. 215].

More-at-risk areas in rapidly expanding cities are likely to house a larger proportion of lower-income population, informal settlements and also newcomers to the city [10,32,35,36]. One of the reasons is that land is affordable and vacant in these areas due to the combination of environmental hazards and lack of infrastructure and services [32]. Another reason is that works for protecting certain parts of the cities (often business centers and affluent neighborhoods) generally increase risks in others areas [35].

Migration and displacement, including secondary migration, are among the adaptation options to face and cope with GEC effects, particularly in the case of sea level rise and low-lying coastal cities [15]. Sudden events like hurricanes and flash flooding trigger massive evacuation and population displacement, which is generally to nearby areas and short-term [37]. Instead, relocation and migration are likely to be included among the planned responses to SLR in coastal cities [30]. Deterioration of cities' appeal — for example due to erosion of beaches due to storm surges (e.g. [34]) or increasing stress due to water scarcity [11] — is another concern. In cases of deteriorating conditions in cities, the reduction of incoming migration flows, reversing the flows or switching to circular and temporary migration is a possibility as migration responds quickly to changes in local conditions in destination areas (e.g. [38]).

(b) Cities are the most common destinations of migration inflows, and environmental change outside of cities can exacerbate the influx of migrants to cities. Although its contribution to urban growth tends to decline over time as the urbanization transition progresses, migration is still an important component of urban growth in most of the developing world [39]. This includes not only the traditional large metropolitan areas but also medium cities with more diversified economic and educational opportunities, and even small cities, frequently a first step in the migration journey [31].

In the context of global environmental change, GEC events can increase migration flows to urban areas temporarily or permanently. Large and *sudden* increases in the inflow of migrants can lead to an accelerated urbanization — particularly the expansion of slums or neighborhoods in vulnerable areas — which may overwhelm the city's capacity to deliver services (education, health, public safety, etc.) and increase the population at risk, particularly in small urban centers [4••,31]. Recent research on Kiribati and Tuvalu [40] points to this situation. Internal migration is fueling urban growth in these two countries (particularly in the national capitals of South Tarawa and Funafuti). The study found that migration to cities is triggered by economic and environmental issues, among them coastal erosion and gradual salinization of drinking water and agricultural land.

Changes in water availability (deficit and excess) are also likely to trigger environmental migration to cities [6•,27]. In particular, droughts severely affect rural livelihoods based on rain-fed agriculture and even those based on irrigation [4••]. The predicted increase in the frequency of droughts coupled with slower recoveries is expected to lead to higher environmental hardship in rural agricultural areas of developing countries, and to the concomitant intensification of rural–urban migration in the form of short-term and circular moves [1••,4••]. For the case of India, Revi [11, p. 209] estimates that climate-change-induced drought and conflict over scarce resources in the Indian countryside are likely to increase the intensity of rural–urban migration in the near future. In the semiarid Northeast of Brazil, regional rural–urban migration and urban growth have also been related to the negative effects of droughts in agriculture, while growing populations in cities generate a concentrated demand for water that surpasses local availability [23].

The impact of Hurricane Katrina on New Orleans: displacement, return and resettlement

Recent research on New Orleans in the aftermath of Hurricane Katrina illustrates the impact of climatic events on cities, the relevance of pre-existing vulnerability, the triggering of out-migration flows — in the form of mandatory evacuation and displacement — and the troubled return. At the same time, this example offers a glimpse of some of the issues surrounding the arrival of displaced population to other urban centers.

Hurricane Katrina hit New Orleans on August 2005, causing extensive flood damage due to the failure of the levee system, and the evacuation and displacement of most of the city population [25]. The hurricane impacted black and

low-income population disproportionately, as these groups were heavily concentrated on the more vulnerable lower-lying areas [41•]. Areas of extensive flooding matched neighborhoods where also social vulnerability was particularly high [42]. Residents were allowed back in the city at the end of September 2005, and by mid-2008 the population was estimated to be about 312,000.

However, not all the evacuees went back to New Orleans. In their study of the dynamics of displacement and return, Fussell and others found that disparities by race and socioeconomic status affected the return of the displaced population [41•]. Their results showed that the longer the duration of displacement, the lower the probability of return. In turn, socioeconomic status and race were highly related to the duration of displacement, which tended to be longer for black residents. However, the key underlying factor affecting the return to New Orleans was the degree of household damage. The authors linked this finding to the pre-existent residential and social segregation in the city, which concentrated disadvantaged population in lower-lying areas.

Socioeconomic status and race were also relevant factors in two studies looking at the displaced population in the cities of Colorado Springs, Colorado, San Antonio, Texas, and Salt Lake City, Utah, which received a large amount of evacuees. Hunt and others examined the interactions between the host, predominantly white, and guest, predominantly black, communities in these cities, looking at the effect of race on the reception of evacuees [43]. Their results showed prevalent racial prejudice in the host communities, as expected, and a second finding was the perception that the evacuees represented an economic and social threat. The authors concluded that these two factors translated into weak support for continued assistance of the guest population. A second study examined the case of low-income displaced population in Austin (TX), focusing on the interactions between evacuees and service providers [44]. Lein and others also found large differences among the host and guest community in terms of race and socioeconomic characteristics. The evacuees experienced extended hardship in terms of unemployment, food insecurity, transportation and housing needs, and lack of health services, despite coordinated relief efforts. Poverty status previous to the disaster and the loss of social networks and livelihoods were found to be significant explanatory factors. From the perspective of the city staff, the arrival of the evacuees put a heavy strain on the city's social service system, and the bureaucratic confusion and long-term perspective of the task added to the perceived burden.

Final remarks

This brief review addressed the interactions between environmental migration and human settlements in the context of global environmental change. In an increasingly urban, mobile and interconnected world, cities are main destinations of migration inflows while also being exposed to the impacts of GEC events such as SLR, sudden flooding, storm surges and droughts.

The planning of adaptation and mitigation measures and urban planning in general need to consider this dual role in order to anticipate the possible impacts and consequences of displacement and migration to and from cities, at different levels. At the country level, the vulnerability of urban populations can be decreased through measures of decentralization that discourage further coastal urban growth and industrialization [4••,30]. At the city level, service provision and human security in deprived urban areas, for example slums, need to be increased [1••]. At the community level, the case of New Orleans illustrates the importance of taking into account the needs and rights of both migrants and the native population, as a way to prevent hostility and facilitate understanding.

In terms of research, there is still much to be understood about the interactions between environmental migration, cities and GEC. Overall, the analysis of mobility is not usually incorporated in the analyses of the effects of GEC in cities and urban areas in general, and the inclusion of destination areas in the analysis of environmental migration is not common, with exceptions (see [6•]). Knowledge gaps call for more applied and interdisciplinary research, while policy-oriented research requires dialogue and collaboration between policy makers, practitioners and researchers.

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