

COMMENT

CLIMATE CHANGE Future droughts will threaten food security **p.450**

SOCIOLOGY Scientists mark their tribes with tattoos **p.454**



MATHEMATICS Persi Diaconis on magic tricks and card shuffles **p.457**

OBITUARY Ralph Steinman, the discoverer of dendritic immune cells **p.460**



Families in Bangladesh seek safer areas after severe floods in 2007.

Migration as adaptation

Mobility can bring opportunities for coping with environmental change, say **Richard Black, Stephen R. G. Bennett, Sandy M. Thomas and John R. Beddington.**

The effects of global environmental change, including coastal flooding, reduced rainfall in drylands and water scarcity, will almost certainly alter patterns of human migration. Conventional narratives usually cast these displacements in a negative light, with many millions of people forced to move, and tension and conflict the result. Our study suggests that the picture is not so one-sided.

The study, the UK government's Foresight report on migration and global environmental change, examines the likely movement of people within and between countries over the next 50 years¹. It contends that, although environmental change will alter an already complex pattern of human mobility, migration will offer opportunities as well as challenges. The greatest risks will be borne by those who are unable or unwilling to relocate, and may be exacerbated by maladaptive policies designed to prevent migration. It is time for a fresh discourse — and fresh research — on migration in relation to global environmental change.

International action and research are needed to identify the positive and negative outcomes of migration influenced by environmental change. Whether movement occurs within or between countries, there is a need to prepare for it and in some cases enable it. It is important to deepen understanding of how migration will affect other types of social change, such as the evolution of cities, the formation of 'poverty traps' and the coexistence of cultures. Current policy frameworks should take account of these factors to avoid having to deal later with impoverishment and displacement under high-risk conditions.

THE REALITY OF MIGRATION

Many people across the world are already migrating, motivated by strong socio-economic factors. The United Nations estimates that there are about 210 million international migrants, but as many as 740 million internal (intranational) migrants². People migrate for complex reasons: to improve incomes; to join family members; to escape persecution; and to remove themselves from environmental or other threats, often temporarily. Such

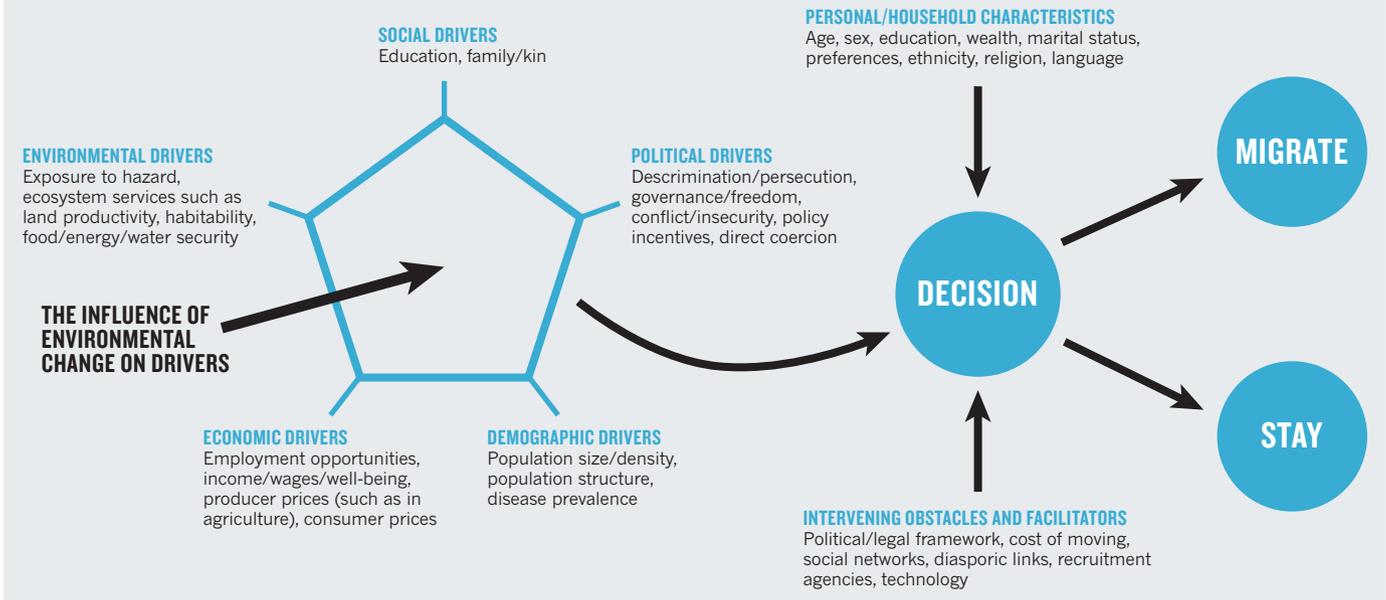
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THE DRIVERS OF MIGRATION

Many factors influence whether a person or family will migrate. Their effects are closely intertwined, so it makes little sense to consider any of them in isolation.



► drivers will change in their proportions over coming decades, but how they influence people's decisions about where they live will not (see 'The drivers of migration').

Environmental factors will increasingly influence migration. Current greenhouse-gas emissions are already committing the planet to likely climate changes in the next 20 years. In Bangladesh, for example, moving to cities has become a common coping strategy in the face of flooding. In a 2008 study, 22% of households affected by tidal-surge floods, and 16% affected by riverbank erosion, moved to urban areas³. Diminished soil quality in Kenya has led people to travel to diversify their income. In 2004–05, for example, temporary labour migration in households that were farming land with high-quality soils was 67% lower than in those using poor soils⁴.

Not everyone is able to migrate. There may be confounding socio-political factors, such

as in Somalia where armed conflict restricts movement⁵, or in New Orleans, Louisiana, where the evacuation plan for Hurricane Katrina assumed that everyone had access to a car⁶. Migration is often expensive, and those most vulnerable to environmental change are usually poor. For example, in Uganda, a relatively settled country with high 'entry costs' for housing, schools and marriage, those who are wealthier are more able to relocate. In Mali, emigration decreased during the severe droughts of 1983–85 alongside a rise in rural poverty⁷.

INTERLINKED FACTORS

Environmental change can increase the incentive to move, but it can also limit the capacity to do so. It should be seen as affecting the many linked drivers of migration.

People are as likely to migrate into places of environmental vulnerability as away from

them — a point that has been insufficiently acknowledged. In rapidly growing megacities, such as Dhaka and Lagos, that are located in delta and coastal floodplain regions in Africa or Asia, hundreds of millions more people may be at risk of flooding by 2060 (see 'Urban coastal flood risk'). Migrants stretch the capacity of existing infrastructure, especially in low-income countries, and new arrivals are frequently vulnerable. In Dakar, Senegal, for example, 40% of those who moved there between 1998 and 2008 live in areas of high flood risk⁸.

Political instability, poor governance, conflict and social pressures compound these problems. For example, Zimbabwe's political and economic crisis, amplified in rural areas by drought, has contributed to the migration of between 1.5 million and 2 million Zimbabweans to South Africa since 2000. In 2008, attacks against these migrants resulted in 65 deaths and the further displacement of 150,000 people⁹.

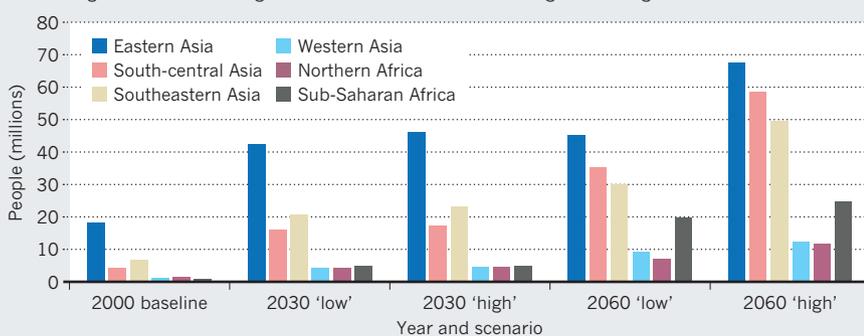
In many cases of mass migration, especially when coupled with environmental hazard, humanitarian assistance might be needed. And such upheavals may have political ramifications. If sea level rise were to engulf a small island state, for example, it would raise issues of sovereignty, and questions of who is responsible for displaced populations.

Migration may be the most effective way to allow people to diversify income and build resilience where environmental change threatens livelihoods. It is therefore necessary to make channels for voluntary migration available.

Within countries, this implies removing arbitrary restrictions on movement, and

URBAN COASTAL FLOOD RISK

The number of people living in cities that are at risk of coastal flooding is set to increase dramatically over the coming decades in both 'high' and 'low' scenarios of economic growth and governance*.



A. DAMATO/PANOS



Poverty trap: residents of this slum in Luanda would find it hard to avoid environmental changes.

providing basic infrastructure to enable relocation and settlement in urban areas, ideally sustainably. Internationally, this might include the extension of regional economic communities to cover the free movement of people as well as money and goods. Those at risk of being trapped — the poorest and least mobile — require additional measures, such as functional early-warning systems and tested emergency evacuation plans, to minimize their vulnerability to extreme events (see ‘Trapped populations’).

A ROAD MAP FOR ACTION

For international policy-makers, climate mitigation and the reduction of negative environmental change should continue to be priorities. But mechanisms for funding adaptation to climate change also need to account for migration as a way of building resilience. It is therefore important that long-term initiatives, including for example those instigated under the United Nations Framework Convention on Climate Change, recognize the links between global environmental change and migration.

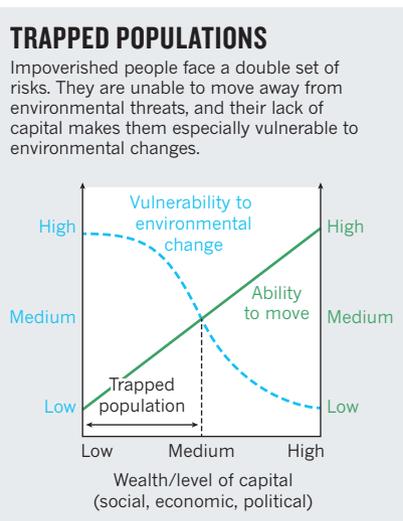
These initiatives should consider the realities of migration, including benefits as well as challenges. And they should focus on the resilience of populations that are moving to, or are trapped in, urban areas that are vulnerable to environmental change, particularly in low-income countries.

Other actions to boost resilience — including sustainable urbanization, climate-smart development, conflict resolution and emergency preparedness — need to take account of an increased propensity for people to migrate. Planners will need to provide

flood-control, water-management, forecasting and warning capacities to growing urban populations. Furthermore, migrants may be socially excluded and so will need special attention.

To increase the potential benefits of international migration, policies can link its adaptive advantages for some migrant communities to demographic deficits and labour shortages in potential host nations. Circular migration schemes are one option, to allow those in environmentally vulnerable areas to work seasonally or on a temporary basis in countries where their skills are in demand. A strategic international approach to migration also needs to pay attention to regional and global demand for skilled workers in particular sectors.

Whole populations need not abandon



their former homes. Migration of some individuals can help a community to remain viable in the long run, for example if money and goods are sent back to help build their resilience. In Africa, where the majority of international migrants stay within their subregion, such remittances to home communities quadrupled to nearly US\$40 billion between 1990 and 2010, surpassing official development assistance since 2007 (ref. 10).

Researchers in the fields of development, climate and environmental science, and climate adaptation need to pay more attention to migration. A better understanding is required of the extent to which migration influences vulnerability and resilience in the face of environmental change. So, too, is clarity on the adequacy of policy responses to address the impact of global environmental change on migrant and non-migrant communities. Such knowledge must be based on empirical research, and underpinned by longitudinal data on migration flows.

It is vital for the research community to provide insights into what outcomes can be expected, and the Foresight project provides a framework with which to start this endeavour. ■

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SOURCE: REF 1