Climate Change, Migration, and Megacities: Addressing the Dual Stresses of Mass Urbanization and Climate Vulnerability

Miles DePaul

Balsillie School of International Affairs, Wilfrid Laurier University

This article assesses the dual stresses that climate change and climate-induced migration are imposing on megacities in developing and emerging market countries. While cities in these countries are experiencing unprecedented urbanization, impacts of climate change such as desertification, flooding, and sea level rise will likely further increase urbanization and put additional pressure on physical and social infrastructure. Cities are not impervious to the impacts of climate change and as populations grow, these stresses will become more pronounced, especially if infrastructure and regulations remain underdeveloped. This article draws on two cases, Bangladesh and India, to illustrate the forces that are causing involuntary mobility from rural to urban areas and the consequent stresses that megacities like Mumbai will experience. It concludes with recommendations to develop comprehensive climate adaptation policies in order to limit the impacts of short- and long-term climate change on cities and the economic cost of such investments in the future, and to seek a normative shift on the issue of climate-induced migration to ensure that those victimized by anthropogenic and natural climate change are met with a compassionate, coordinated global regime.

Introduction

As evidence on the implications of a changing climate builds, migration is becoming a salient consequence of unabated greenhouse gas (GHG) emissions and poor climate risk adaptation. The scientific consensus is that warming of the climate system is "unequivocal" (IPCC 2007)—a term not freely used in the scientific community. With an increase in global temperatures and climatic variability, there is a higher risk of an increase in migration-inducing events, such as droughts, desertification, flooding, soil erosion, and transmission of airborne diseases, and other societal and ecological incidents. Megacities, defined as metropolitan areas with a total population in excess of 10 million people (Rana 2011, 240), are becoming focal points for climate change impacts and mass urbanization that in turn result in growing vulnerability to environmental and social change. The intersection of climate

change impacts and mass urbanization creates dual stresses on megacities: the stress of mass urbanization hinders the ability of megacities to adapt to the stress of climate change. This creates a negative feedback loop whereby climate change adaptation becomes progressively more difficult because of inadequate housing, infrastructure, resource supplies, and social services.

There are prominent examples of the severe impacts of climate change, particularly in developing and emerging market countries where poor health is often exacerbated. The World Health Organization (2008, 2) reported that a warmer and more volatile climate is expected to increase the already high instances of annual deaths related to natural disasters (60,000), urban air pollution (800,000), diarrhea (1.8 million), and malnutrition (3.5 million). The Intergovernmental Panel on Climate Change (IPCC), the leading international body for the assessment of climate change established by the United Nations Environment Programme and the World Meteorological Organization in 1988, indicates that there is "high confidence" in the scientific community that anthropogenic climate change is contributing to sea level rise and consequent high-risk scenarios for coastal cities without proper infrastructure (IPCC 2007, 7). Megacities such as Dhaka, Bangladesh, and Calcutta, India, typically rank among the most vulnerable coastal cities (WWF 2009, 2). Furthermore, as Priyanka Anand and Kallidaikurichi Seetharam (2011, 28) suggest, "when we consider that currently 13 out of the largest 20 megacities in the world are coastal cities, the grave situation facing urban populations around the world becomes poignantly apparent." Climate change is undoubtedly a global problem, one that becomes more challenging over time as it continues and more people move to cities.

While estimates vary, a conservative estimate is that annual migration to urban centres because of environmental change currently totals approximately 50 million people (Warner 2010, 697). Reasonable estimates by the International Organization for Migration suggest that the annual migration total could reach 200 million by 2050 (ibid.). If meaningful global action on climate change is not taken by 2020, there is a high likelihood that Earth will experience a series of tipping points, or irreversible events whereby the required mitigation becomes nearly impossible, causing significant yet unpredictable impacts on human mobility patterns. Nick Mabey (2009, 2) assesses that "these 'worst-case scenarios' are not low probability, but largely inevitable under current momentum of economic behaviour. As atmospheric concentrations [of carbon dioxide] increase, there is little uncertainty over whether extreme impacts will occur, only when they will happen." Migration will likely become a necessary survival option for individuals in an increasing number of vulnerable regions.

Most affected by climate impacts and climate-induced migration are highly vulnerable cities, notably megacities in developing and, to a lesser degree, emerging market countries where the physical, social, and regulatory infrastructure is typically insufficient to address these emergent stresses. As of 2007, more people live in cities than in rural areas for the first time in history, while more and more cities are growing past the population mark of

10 million (Bhagat and Mohanty 2009, 7). Meanwhile, cities are increasingly vulnerable to climate impacts because of "coastal location, exposure to the urban heat-island effect, high levels of outdoor and indoor pollution, high population density, and poor sanitation" (Campbell-Lendrum and Corvalan 2007, 1). These concurring trends have resulted in unprecedented pressure on megacities.

Research on the intersection of climate change and migration and their combined impact on megacities is still in its infancy and hence insufficient in the face of critical policy questions on the subjects of mitigating climate change and building resilience to impacts. Scholars, such as Alex de Sherbinin, Andrew Schiller, and Alex Pulsipher (2007), Diarmid Campbell-Lendrum and Carlos Corvalan (2007), Mobarak Khan, Alexander Kramer, and Luise Prufer-Kramer (2011), and Hilary Bambrick et al. (2011) assess the health and social impacts of climate change on cities and megacities, broadly concluding that climate change should be seen as a significant issue for cities and policies at all levels of government need to be designed to reflect this. These studies fall short of mentioning the added stresses that mass urbanization could impose on cities. Scholars such as Imtiaz Ahmed (2009), Cecelia Tacoli (2009), and Nicola Ranger et al. (2011) look at migration patterns and climate-induced urbanization in developing and emerging market countries. Their studies suggest that physical and social infrastructure currently cannot cope with mass urbanization. These scholars neglect to consider the stresses that climate change will impose on overpopulated regions. Only Susana Adamo (2010) considers the interrelation of migration, climate change, and cities, though she investigates theoretical implications rather than evaluating specific national and regional policies. Institutions, like the United Nations Population Fund, conduct extensive research on trends in population, climate change, and urban density (see, for instance, Dodman 2009), but the connection to migration is seldom made.

In order to assess the coinciding effects of climate change and climate-induced migration on megacities, this article will first outline a typology of climate migrants and refugees by considering the impacts of climate change as multipliers to current push factors of migration. It will then analyze the stresses that climate change imposes on megacities, particularly the dual stresses of mass urbanization and increasing climate vulnerability. It will then utilize a case-specific analysis of the interconnectedness of developing and emerging market countries to illustrate the forces that drive involuntary international and intranational mobility from rural to urban settings, and the subsequent stresses megacities experience and will continue to experience in upcoming decades. The case of Bangladesh is examined because the country is especially vulnerable to climate change and Bangladeshis have a history of migration to safer regions in Bangladesh and neighbouring India. Climate-induced migration within India demonstrates the physical, economic, ecological, and cultural shocks that megacities such as Mumbai will likely experience in the future. Case methodology shows how climate-induced migration has many facets, both international and intranational, and suggests

that major urban centres are disproportionately impacted. This article concludes by arguing that there is a need to move past the stifled debate on the inclusion of climate migrants in the international migration regime and acknowledge that climate change is having real impacts on migration patterns and, in turn, the capabilities of megacities to accommodate influxes of people. Two policy recommendations are proposed. First, the development of local policies, predominantly related to adaptation projects and mitigation initiatives, is necessary to build resilience to climate change. Second, a normative shift on the issue of climate-induced migration is needed to ensure that those victimized by anthropogenic and natural climate change are met with a compassionate, coordinated global regime rather than strict national immigration policies, like those currently employed in India.

Climate Refugees as Victims: A Typology

Maggie Ibrahim (2005, 171) cautions against the use of the term "threat" when discussing migration because doing so "lays the foundation for an increasingly interventionist style of international relations . . . By shrouding migrants within a context of threat and insecurity, a dichotomy forms between host states (us) and migrants (them)." This line of thinking is likely what influenced Lester Brown, founder of the Worldwatch Institute and Earth Policy Institute, to introduce the term "environmental refugee" into the international migration lexicon, a term which puts the onus on states to be compassionate to victims of environmental volatility (Brown 1977, 1). The terms "environmental refugee" and "climate refugee" are often met with reservations from agencies such as the Office of the United Nations High Commissioner for Refugees (UNHCR), which prefers the term "environmentally displaced persons" because of the historical and legal weight that the term "refugee" holds in the international system (Biermann and Boas 2010, 66). But the refusal to be flexible with the term "refugee" in order to account for current and predicted future migration forces is the refusal to acknowledge a changing global dynamic.

Climate change creates three parallel categories of push factors that induce migration and there are three corresponding conceptions of migrants: traditional migrants, traditional refugees, and climate refugees. First, sudden-onset climate-related disasters such as floods and hurricanes are push factors that are already resulting in forced migration from disaster areas. Many scholars argue that individuals who are temporarily or permanently forced off of their land "because of a marked environmental disruption" should be considered "climate refugees" (Warner 2010, 694). Such disasters are identifiable fear-and-consequence-driven push factors. Whereas the 1967 Refugee Protocol relating to the Status of Refugees focused on "fear from persecution" for reasons of "race, nationality, religion, membership in a particular social group, or political opinion" (ibid.), modern conceptions of fear, and thus of refugees, include fear of otherwise unavoidable natural forces. Fear in both cases is rooted in the desire for survival and security from threats—predominantly political threats in the former case and natural threats in the latter. The definition of "refugee"

needs to remain clear so as to maintain the effectiveness of the Refugee Protocol. Yet, the definition, as well as the review process, also needs to be flexible in order to adapt to ever-changing threats. A definition that equates "fear from persecution" with the very real fear from climate-related natural disasters would create new migration norms and simultaneously advance the urgency of mitigating climate change risks.

Second, slow-onset climate impacts such as soil erosion and desertification are push factors which magnify current "interacting physical and social variables, including agricultural and economic decline that ultimately force people from their homelands" (Homer-Dixon 1991, 1). These indirect, aggregated phenomena are largely unaccounted for by states, hence individuals on the move tend to be classified as migrants rather than refugees. Climate refugees' claims—for example, the lack of employment opportunities and unacceptable socio-economic conditions—are often similar if not identical to traditional migrants' claims. Individuals are eventually forced to migrate because of exogenous threats to housing and sustenance; moving is often a decision of last resort. The distinction between traditional migrants and climate refugees helps to understand the contemporary factors influencing migration, particularly as climate-induced migration becomes a more prominent issue. Embedding climate-induced migration within traditional migration definitions eliminates the nuance that is required to better address causes and effects, and thus limits the potential for effective solutions.

A third climate-related push factor category marries the first two categories above: slow-onset climate impacts and sudden forced migration. A changing climate's impact on agricultural production and natural resources will lead to what Thomas Homer-Dixon (1991, 1) calls "acute national and international conflict." He (ibid.) explains that "countries may fight over dwindling supplies of water and the effects of upstream pollution. In developing countries, a sharp drop in food crop production could lead to internal strife across urban-rural and nomadic-sedentary cleavages. If environmental degradation makes food supplies increasingly tight, exporters may be tempted to use food as a weapon." This third category remains under-researched. There is some disconnection between climate and conflict models. These predictions indicate that in the event of mass migration, states must avoid costly and irresponsible militarization and instead implement more rational and compassionate policies. Conflict in populous regions like Southeast Asia and sub-Saharan Africa would likely lead to forced migration and individuals forced from their lands would be classified as traditional refugees according to UNHCR.

Given these three categories, one of the fundamental challenges for the current international migration regime is to reconcile the likely trend of climate-related migration with the global shift to stricter border controls and immigration policies in light of the perceived threats of terrorism and illegal immigration. The international community is approaching a crossroads where a country's national immigration policies will determine many of its

future development and security outcomes. As Tacoli (2009, 515) argues, "[p]olicies that support and accommodate mobility and migration are important for adaptation and the achievement of broader development goals. However, in most cases migration is still seen by many governments and international agency staff as disruptive and requiring control and restrictive measures." In short, there is a need to reconceptualize strict national immigration policies in the face of climate-induced migration and this need has larger social and developmental justifications.

Having outlined push factors, a typology of migrants, and the need for flexible definition of "refugee," this article now turns to how the dual stresses of mass urbanization and increasing climate vulnerability are putting previously unseen stresses on cities around the world. It will investigate how appropriate evidence-based policy-making on climate change mitigation and adaptation will help limit instances of the aforementioned push factors.

The Dual Stresses of Climate Change on Cities

Large cities are experiencing both mass urbanization and increasing vulnerability to climate change impacts, dual stresses that are unique to the 21st century. These stresses are putting pressure on the abilities of cities, primarily megacities in developing and emerging market countries, to provide basic services and support for their populations. Accelerated population growth in cities means that local governments must deal with residence overflow, diminished sanitation, high transit demand, and other social and welfare pressures. At the same time, cities are increasingly vulnerable to climate impacts such as floods and heat waves, which can exacerbate these varying pressures. Ranger et al. (2011, 140) argue that "many of the world's cities are hotspots of risk from extreme weather events and levels of risks in many cities are likely to grow due to a combination of population growth and development and rising intensities of extreme weather events." If the dual stresses, which cities will continue to experience, are not fully acknowledged and properly addressed, all levels of government and international governance structures will put populations and basic physical and social infrastructure at undue risk. As mass urbanization continues, climate refugees will be leaving one vulnerable zone for another.

By comparing the contemporary reality that more people live in cities than rural areas to the fact that only 13 per cent of the world's population lived in cities during the early 20th century, it is evident that mass urbanization will impose societal, economic, and cultural pressures on urban centres, since there is currently less space and fewer resources to be shared or distributed (Bhagat and Mohanty 2009, 6). Pressures include new burdens on transit infrastructure, increased competition for jobs, and reduced provision of social services. Instances of xenophobia may increase because some people might make a connection between migration and deteriorating conditions. Furthermore, over 900 million people—more than 70 per cent of urban populations in developing countries—currently live in slum-like conditions,

with this number expected to increase to two billion over the next 30 years (Little and Cocklin 2009, 77). Slum-like conditions are characterized by "low incomes, poor housing and provision of basic services, and no effective regulation of pollution or ecosystem degradation" (Campbell-Lendrum and Corvalan 2007, 111). While some studies suggest that urbanization can be a "positive force in overall poverty reduction" (Ravallion, Chen, and Sangraula 2007, 5), this is only possible if urbanization is met with robust social and physical urban infrastructure. Masud Rana (2011, 243) suggests that "urbanization and rapid urban change may be a negative sign of development provided the urban problems arise due to improper management and unplanned growth." Given the poor infrastructure conditions in a number of impoverished regions, like Bangladesh, climate-induced migration will likely lead to unplanned growth in megacities and management of this growth will probably be inadequate. If natural disasters, land degradation, or conflict result in sudden mass movements of people, megacities may experience the "urbanization of poverty," which would send shocks through societies and the global economy as prospects for equitable economic growth deteriorate. While it would be wrong to generalize that these claims apply to all of the world's 26 megacities, the policy issues at hand could certainly become salient in megacities like São Paolo, New York City, and London, where mass urbanization and climate change are already major concerns for local governments.

As cities begin to grapple with the prospects of increased urbanization, they are becoming increasingly vulnerable to the impacts of climate change. As Adamo (2010, 162) points out, "a large proportion of urban expansion is taking place in areas exposed to environmental hazards, [for example] low lying plains, coastal zones, stepped slopes and drylands." Notably, while coastal zones represent only 2 per cent of total land in the world, they are inhabited by 14 per cent of the world's overall population and 23 per cent of its urban population (ibid.). Inherent vulnerabilities like proximity to coasts and low river deltas are exacerbated by lax building codes, poor sanitation and waste policies, and the lack of resilience systems such as dams and dykes (de Sherbinin, Schiller, and Pulsipher 2007, 45–47). De Sherbinin, Schiller, and Pulsipher (ibid., 41) best explain this mix of stress and vulnerability: different pressures across scales come together in various sequences to create unique "stress bundles" that affect local systems. Significant consequences can result when stresses emanating from the environment coalesce with those arising from society. The concurrence of stresses synergistically enlarges the vulnerability of a system and risks then emerge from multiple sources and at different scales.

The dual stresses of mass urbanization and increasing vulnerability to climate impacts create stress bundles. To illustrate the consequences of these dual stresses for megacities, the next section will examine two complementary cases. One is a case of international migration from Bangladesh to India and the other is a case of intranational migration from rural regions in southern India to Mumbai.

Dual Cases: Bangladesh and India

This section analyzes historical trends in and future projections for Bangladesh, a developing country, and India, an emerging market country. The instances of the dual stresses and their consequences in these two cases are examples of a global problem. Many countries in Africa and South America are experiencing similar challenges. For example, ActionAid (2006, 2) looks closely at the impact of climate change on six African cities while frequently commenting on the added pressure that urbanization puts on flood resistance and public safety. Adamo (2010, 163) discusses an example in northeastern Brazil where "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." The dual stresses are evidently not unique to specific cities and regions, especially when trends and future prospects are considered.

In choosing cases to exemplify aforementioned statistics and arguments, this article needed to select a region that has recently dealt with mass urbanization and climate-related pressures so as to offer a historical perspective that is instructive in indicating likely future occurrences in other regions. The criteria used to select a case were: (1) presence of a megacity, defined as a metropolitan area with a population in excess of 10 million; (2) proximity to common climate risk zones such as coasts, deserts, and low-lying plains; and (3) historical trends of migration between neighbouring countries. The cases of Bangladesh and India were ultimately selected because of the presence of Mumbai, a coastal city that has been experiencing mass urbanization. This trend suggests that a migration channel exists; there is a history of migration between Bangladesh and India typically due to economic push factors. These factors will likely be exacerbated by climate change. The cases also satisfy the criterion of vulnerability given proximity to coasts and deserts, characteristics that are quite common among the world's 26 megacities. It is important to note that specific conclusions drawn from these cases, including exact climate risks, numbers of expected climate refugees, and overall risks, cannot be applied to other megacities. However, the resulting policy recommendations, which are transferable, should be applied globally.

According to the IPCC (2007, 7–22), the main climate change impacts in the India–Bangladesh region are increased frequency of droughts and floods negatively affecting local production, sea level rise exposing coasts to risks such as coastal erosion, and glacier melt in the Himalayas with more flooding and rock avalanches. The convergence of these impacts would likely lead to consequences for migration patterns and, subsequently, substantial pressures on societies in the region. Following discussions of historical trends, this section outlines the potential impacts that climate change will have on migration by first looking at international migration from rural Bangladesh to urban India and then at internal migration from rural to urban India.

International migration from Bangladesh to India

Migration from Bangladesh to India has historically been a prominent issue because of the persistent economic inequality and related differences in social well-being between the two countries. The impending impacts of climate change, particularly in southern Bangladesh, are expected to aggravate tensions on the highly sensitive India–Bangladesh border. Bangladesh is one of the countries most vulnerable to climate change because of exposure to climate-related natural disasters, agriculture dependency, and its government's inability to adapt (Maplecroft 2010). Expected impacts include poor soil, water, and air quality and natural disasters such as floods, droughts, and tropical storms (Poncelet et al. 2010, 212). According to Maplecroft (2010), a British global risks analysis company, the Southeast Asian region and in particular India and Bangladesh are most vulnerable to climate change, and in fact are already experiencing elevated risks: "Throughout 2010, changes in weather patterns have resulted in a series of devastating natural disasters, especially in South Asia, where heavy floods in Pakistan affected more than 20 million people (over 10% of the total population) and killed more than 1,700 people. There is growing evidence climate change is increasing the intensity and frequency of climatic events."

Migration patterns will be especially affected by sea level rise and riverbank erosion, which are already contributing to "impoverishment and marginalization of rural families due to the loss of productive agricultural lands" (Poncelet et al. 2010, 213). Some scholars predict that environmental calamities in Bangladesh will primarily result in internal migration from rural to urban areas (ibid.), while others predict that in the medium to long term, more precarious scenarios will result in migration to its most affluent neighbour, India (Ahmed 2009, 297). A key observation is that "even a meter rise in sea level would inundate half of Bangladesh's riceland, forcing the relocation of easily 40 million people. In a densely populated country . . . internal relocation would not be easy" (ibid.). Bangladesh's population has in fact increased from 144 million at the time of Ahmed's 2009 study to roughly 158 million (CIA World Factbook 2011). Notably, Richard Black, Dominic Kniveton, and Kerestin Schmidt-Verkerk (2011, 445) argue that, given the economic inequality between Bangladesh and India, "it is likely that a significant proportion of any growth in migration that might result from rural impoverishment associated with the negative impacts of climate change could be seen in international migration to India; indeed, such cross-border migration is already arguably the largest bilateral migration flow in the world, larger even than flows from Mexico to the United States." Climate change is catalyzing additional international migration, which is straining relations between the countries. An estimated 20 million Bangladeshis are living illegally in India, a situation that has become "a major source of tension between the two countries" and has generated "a host of destabilising political, social, economic, ethnic, and communal tensions in many states and union territories of [India]" (Alam 2003, 423). Climate-related pressures in

Bangladesh may put India–Bangladesh relations under even greater strain in the coming decades. As such, India is pursuing stricter border security policies, which include the construction of a three-metre-tall barbed-wire fence along nearly the entire India–Bangladesh border (Ahmed 2009, 303). India has so far fenced over 4,000 kilometres of the border and constructed roads and floodlights to prevent illegal migration (Jones 2009, 293).

India's strict border security policies, coupled with the Bangladeshi government's consistent denial of "any illegal movement of people from Bangladesh to India," are producing "stateless persons" in this region (Ahmed 2009, 302). Ahmed (ibid.) explains that "in the midst of governmental politicking, with the Bangladesh government disowning the environmental refugees as 'citizens' of the country and the Indian government calling them 'illegal migrants' and taking measures to push them out of India, the victims of environmental disruptions, including (mal)development, end up losing protection from both countries." That is, these victims lose protection of their basic rights and face the constant threat of deportation and abuse from local police and residents.

In addition to political and often cultural exile, these migrants tend to be relegated to live in slum-like conditions. Alice Poncelet et al. (2010, 216) discuss the vicious cycle for climate refugees as it pertains to India:

> Many slums where migrants had settled have been destroyed by the government, because they were illegal. The government is not implementing any resettlement or rehabilitation plans, but has closed down several slums. In such situations, people move from one slum to the other. At first, these people are determined not to move back to their original places, unless there are possibilities to earn a decent living. However, people are tired of moving all the time without achieving any improvement in quality of life, so when they are faced with this additional and unexpected difficulty (closing of the slums), some migrants chose to return to their place of origin.

The individuals least responsible for climate change—the poor and vulnerable in developing and emerging market countries—are most affected by the consequences of a changing climate. Without a substantive mix of adaptation policies and more-open borders in contexts of forced migration, climate change could result in further impoverishment of the poor, exacerbated stresses on megacities, and violent conflict.

Internal migration in India and its impact on Mumbai

Climate-induced international migration will likely be problematic, but research on the link between climate change and migration indicates that internal migration, or retreatment, is going to be the most significant aspect of climate-induced migration in all regions of the world. In India, climate-related desertification in the south is catalyzing migration to many of the

country's megacities, including Delhi, Kolkata, and Mumbai. One study on desertification and land degradation in India concluded that a 105.5 mega-hectare area of the country, or 37 per cent of the country's total geographic area, is undergoing processes of land degradation and of this, the area undergoing desertification is 81.4 mega hectares (Ajai et al. 2009, 1478). Much of this land is agricultural land in the rural south. The implications for global food security aside, desertification is reducing job opportunities and catalyzing mass migration from the rural south to India's urban centre (Leighton 2006, 48).

Mumbai is an exemplary case of climate-induced mass urbanization and the consequent urbanization of poverty. India's most populous city, Mumbai has a population of approximately 12.5 million residents; its population has increased by one-quarter in the past 20 years (India Online Pages 2011). Much of this population growth is a result of internal migration from the south and international migration from neighbouring countries. These trends are and will continue to be amplified by a changing climate.

Climate change has exacerbated Mumbai's many geographical and infrastructural vulnerabilities. The climate-related July 2005 monsoon flooding that killed more than 1,000 people demonstrated how vulnerable Mumbai really is. Flat topography, low river deltas, poor drainage systems, and lax building codes make the city particularly vulnerable to climate-related pressures (de Sherbinin, Schiller, and Pulsipher 2007, 49). Mass urbanization is a problem on top of these vulnerabilities. According to the Munich Re Foundation (2007), those who died were disproportionately people living in slum settlements, with leading causes of death being drowning, wall collapse, and various diseases. Since over half of Mumbai's population lives in "squatter communities," characterized by single-storey buildings made of salvaged materials and suffering from poor sanitation and restricted access to water, vulnerabilities are only compounded (de Sherbinin, Schiller, and Pulsipher 2007, 49–50). This creates stress bundles. For instance, poorly designed and maintained buildings are damaged by extreme weather events. Local governments, which prioritize urgent capacity concerns like transportation provision, have limited abilities to improve disaster preparedness because of increased pressure on their resources. Local economies slow as more and more individuals become impoverished and are forced into slums. Policy at all levels of government has thus far been ineffective in the face of compounded vulnerabilities and stress bundles. Local governments' underdeveloped adaptation strategies, alongside the federal government's restrictive immigration policies and the international community's general disregard for climate-induced migration, are resulting in worsening living conditions. De Sherbinin, Schiller, and Pulsipher (ibid., 50) argue that "the challenges posed by climate change, especially flooding and sub-surface shifting in landfill areas, are unlikely to be met effectively."

As instances of climate-related pressures increase, life in Indian megacities will continue to be distinguished by vulnerability and poverty, and urbanization will likely continue unabated. The convergence of the

Indian federal government's lax climate change mitigation policies, its attitude toward Bangladeshi migrants, and local governments' ineffectual adaptation strategies make these trends highly likely. Desertification will force many Bangladeshis to seek refuge in India. As desertification continues and water scarcity becomes a reality in India's south, extreme weather patterns, especially flooding, will worsen already precarious socio-economic conditions in Mumbai. India and its major cities will become increasingly vulnerable.

Finding Solutions

The fundamental solution is for all countries to pursue rigorous climate change mitigation policies, given that there is an "unequivocal" scientific consensus that "[m]ost of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations" (IPCC 2007, 5) and that the stresses and vulnerabilities outlined above are respectively climate-related and exacerbated by climate change. Developed countries and countries that benefit disproportionately from oil and coal industries must accept more responsibility for reducing emissions since they are responsible for the majority of emissions currently in the atmosphere. There are many policy options to choose from. Climate change can be addressed through emissions pricing (introducing a carbon tax), emissions caps (establishing a cap-and-trade system), voluntary emissions reduction targets and incentives for industry, and research funding for and development of new emission-reducing technologies.

Coordinating a global response to climate change has to date been difficult because of obstruction by key countries, particularly the United States and China, which results in lowest-common-denominator agreements. Leading up to the 15th Conference of the Parties to the United Nations (UN) Framework Convention on Climate Change in Copenhagen in 2009, the international climate regime was seen as "digging itself into ever deeper holes of rancorous relationships, stagnating issues, and stifled debates" (Depledge 2006, 1). The most recent meeting held in Durban, the 17th Conference of the Parties, produced an agreement that delayed the finalization of a successor treaty to the Kyoto Protocol until 2015 and stated that the new treaty would come into effect in 2020. Reform of the international climate regime has been proposed countless times since its conception in 1992. Trade sanctions and financial penalties, among other compliance mechanisms, have been discussed. The political backlash against such proposals has significantly tempered expectations on reforming the regime, not to mention the persistent tensions between developed and developing countries over the responsibility to reduce emissions. John Drexhage (2008, 1) argues that "to address the multi-faceted climate challenge we face, governance efforts must evolve beyond the current global regime-building model and . . . environmental and development policies must become much better integrated." Global fora are not the only means of addressing climate change. Matthew Hoffman (2011, 5) suggests that "the

center of gravity in the global response to climate change is shifting from the multilateral treaty-making process to the diverse activities found beyond the negotiating halls . . . . in cities, provinces and states, citizen groups, and corporations." It is impossible to remove state actors from the equation, but Hoffman makes an important point: since climate impacts are local, securing local-led and community-owned solutions is a promising way forward.

Since meaningful state action has not been taken at recent UN meetings, grassroots movements promoting mitigation and adaptation strategies must continue to be mobilized worldwide. These movements should promote investment in transportation, renewable energy, and infrastructure and engage individuals, corporations, and not-for-profit organizations. For local and municipal governments, climate change is becoming a real risk factor and policy priority. The C40 Cities Climate Leadership Group, a network of the world's megacities committed to addressing climate change, has emerged to reduce emissions and climate risks. Local action plans can be much more fluid and collaborative, whereas national and international plans have historically been slow-moving and competitive. If national governments do not reconsider their policy stances, the well-being of cities and prospects for sustainable economic and social development are at risk. Governments could help scale up local initiatives through funding and strategic support for transformative ideas and by opening up the regulatory environment to better mobilize capital for impactful work. For example, social and environmental finance could make a difference by funding local solutions to global challenges, but regulatory provisions, such as lending rules, stall action.

Even if all countries reduced GHG emissions to zero tomorrow, the impact humankind has already had on natural systems will continue causing detrimental climate change. As such, resilience policies must be pursued in all countries, particularly those with megacities. The three characteristics of resilience are: (1) the amount of disturbance a society can absorb and "still remain within the state of the domain of attraction;" (2) the degree to which the society is capable of self-organization or adjustment; and (3) the degree to which the society can build and increase the capacity for learning and adaptation (Prasad et al. 2009, 32). Policies include early warning systems, contingency plans, and relief measures. Notably, Singapore has increased the ground level in all reclamation programs and the City of London has redesigned the Thames Barrier flood control system to factor in likely sea level rise due to climate change (ibid., 30). In the pursuit of climate resilience in Mumbai, the Tata Energy Research Institute, an Indian environmental non-governmental organization, conducted a study which concluded that "US$24-million invested in protection against sea-level rise would reduce the economic impact by US$33-billion dollars" (de Sherbinin, Schiller, and Pulsipher 2007, 49). There are uncertainties about what the exact climate impacts on cities and particularly megacities will be, hence scholars such as Bambrick et al. (2011, 71) call for a focus on improving health and quality of life "no matter what climate impacts eventuate" as a more appropriate means of adapting to change. Policy goals include: reducing air pollution contributing to smog,

which will only worsen respiratory conditions as temperatures increase; leveraging community engagement and local solutions to improve early warning systems; and ensuring that adequate health care and preventative measures are available in the event of flooding, resource scarcity, and heat waves (ibid., 72–75). This focus necessitates providing public health clinics for respiratory illnesses, establishing adequate building codes in high-risk regions, and integrating health and well-being into municipal transit policies. In the cities of many developing and emerging market countries, inadequate resilience strategies and poor physical and social infrastructure mean that migration remains the most attractive option.

The prevalence of migration as a means of adapting in the short term suggests that there is a need for a normative shift in the international understanding of and global response to climate-related mobility. Tacoli (2009, 515) argues that "what is needed urgently is a radical change in perceptions of migration, and a better understanding of the role that local and national institutions need to play in making mobility be seen as part of the solution rather than the problem." Most immigration policies try to "influence the volume, direction and types of population movement," hence there is a need to reconceptualize the focus of immigration policies in order to "accommodate changes in migration patterns that result from environmental degradation, economic growth or crisis" (ibid., 523).

A normative shift would mean change at the India–Bangladesh border—it would mean moving away from strict border security, which treats climate refugees as threats, toward developing policies that treat them as victims of an inherently global problem. This perspective would change the international understanding of what is threatening. The events that induce forced migration, like climate change and conflict, would be seen as the real threats. Kim Rygiel (2010, 5) argues that "the increased implementation of border controls on the part of governing authorities has enabled the greater segregation (and differential treatment) of 'legitimate' mobilities such as leisure and business, from 'illegitimate' mobilities such as terrorism and illegal immigration." In order to move beyond the "us" and "them" dichotomy and redefine what is threatening, the root challenges facing the international migration regime must be addressed. Rygiel (ibid., 14–15) highlights an emerging politics of resistance, which involves, for example, the No One is Illegal and No Border movements, which are challenging the securitization of citizenship. Dispelling the notion of the securitized and legalized individual whose rights can be withheld and to whom resources can be denied, which had significant momentum prior to the modern era in border enforcement that linked low security to the risk of terrorist attacks, would lead to changes in border controls in climate-sensitive regions such as the India–Bangladesh border. An example of effective policy would be to divert the abundant resources spent on keeping people out, like on fences, guards, and biometric technologies, toward increasing the resilience of megacities so that they have the capacity to provide for victims of climate change and avoid the perpetuation of slum-like conditions.

Conclusion

With global temperatures and climatic variability increasing, and a corresponding higher risk of an increase in migration-inducing events, 40 million Bangladeshis could be forced to find refuge in nearby safer regions. Historical trends and empirical research suggest that the densely populated cities of India are not only the preferred option, but often the only option for climate refugees. Major cities in Africa, South America, and Asia are similarly vulnerable to many of the climate change impacts discussed above. Stress bundles may emerge to put pressure on governments and perpetuate poverty.

Rigorous climate change mitigation and adaptation policies are needed to avoid such scenarios all around the world. Likewise, a normative shift is needed, particularly in climate-sensitive regions and security discourse, to redefine what is threatening. The cases of Bangladesh and India indicate that the real threat is climate change, not migrants. Without addressing the causes and effects of climate change, what many people perceive as threats from migration will never be resolved.

The problem at hand is undoubtedly global and so systemic change is necessary. The potential implications of mass migration increase the urgency of the situation—all countries may be faced with the consequences of climate-induced migration. Given the prioritization of immigration issues in North America, Europe, and increasingly Southeast Asia, ignoring the empirical evidence suggesting that mass migration is a very likely consequence of climate change would be incompetent policy-making.

The policy recommendations in this article are only the tip of the iceberg and only an initial step in the right direction. Much research is still needed on policy on climate-induced migration to megacities and much more attention is needed from all levels of government. Specifically, there are gaps in knowledge when it comes to understanding the impacts that climate-induced mass migration will have on local economies, food security, education services, and cultures. A better understanding of the potential impacts on each of these areas could lead to even greater urgency on the issue of climate change mitigation and adaptation.

Acknowledgements

Thanks to Dr. Kim Rygiel for inspiring this research, and challenging my assumptions.

References

ActionAid. 2006. *Climate Change, Urban Flooding and the Rights of the Urban Poor in Africa: Key Findings from Six African Cities*. London: ActionAid International.

Adamo, Susana. 2010. "Environmental Migration and Cities in the Context of Global Environmental Change." *Current Opinions in Environmental Sustainability* 2 (3): 161–65.

Ahmed, Imtiaz. 2009. "Environmental Refugees and Environmental Distress Migration as a Security Challenge for India and Bangladesh." In *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts*, edited by Hans Günter Brauch, Úrsula Oswald Spring, John Grin, Czeslaw Mesjasz, Patricia Kameri-Mbote, Navnita Chadha Behera, Béchir Chourou, and Heinz Krummenacher, 295–308. Berlin: Springer.

Ajai, A. S. Arya, P. S. Dhinwa, S. K. Pathan, and K. Ganesh Raj. 2009. "Desertification/Land Degradation Status Mapping in India." *Current Science* 97 (10): 1478–83.

Alam, Sarfaraz. 2003. "Environmentally Induced Migration from Bangladesh to India." *Strategic Analysis* 27 (3): 422–28.

Anand, Priyanka, and Kallidaikurichi Seetharam. 2011. "Climate Change and Living Cities: Global Problems with Local Solution." In *Climate Change and Sustainable Urban Development in Africa and Asia*, edited by Belinda Yuen and Asfaw Kumssa, 21–35. New York: Springer.

Bambrick, Hilary Jane, Anthony Guy Capon, Guy Bruce Barnett, R. Matthew Beaty, and Anthony John Burton. 2011. "Climate Change and Health in the Urban Environment: Adaptation Opportunities in Australian Cities." *Asia-Pacific Journal of Public Health* 23 (2): 67–79.

Bhagat, R. B., and Soumya Mohanty. 2009. "Emerging Patterns of Urbanization and the Contribution of Migration in Urban Growth in India." *Asian Population Studies* 6 (1): 5–20.

Biermann, Frank, and Ingrid Boas. 2010. "Preparing for a Warmer World: Towards a Global Governance System to Protect Climate Refugees." *Global Environmental Politics* 10 (1): 60–88.

Black, Richard, Dominic Kniveton, and Kerestin Schmidt-Verkerk. 2011. "Migration and Climate Change: Towards an Integrated Assessment of Sensitivity." *Environment and Planning A* 43 (1): 431–50.

Brown, Lester. 1977. "Redefining National Security." *World Watch Institute*: 1.

Campbell-Lendrum, Diarmid, and Carlos Corvalan. 2007. "Climate Change and Developing Country Cities: Implications for Environmental Health and Equity." *Journal of Urban Health* 84 (1): 109–17.

CIA World Factbook. 2012. "South Asia – Bangladesh." https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html.

Depledge, Joanna. 2006. "The Opposite of Learning: Ossification in the Climate Change Regime." *Global Environmental Politics* 6 (1): 1–22.

de Sherbinin, Alex, Andrew Schiller, and Alex Pulsipher. 2007. "The Vulnerabilities of Global Cities to Climate Hazards." *Environment and Urbanization* 19 (1): 39–64.

Dodman, David. 2009. "Urban Density and Climate Change." April 2. http://www.unfpa.org/webdav/site/global/users/schensul/public/CCPD/papers/Dodman%20Paper.pdf.

Drexhage, John. 2008. "Climate Change and Global Governance: Which Way Ahead." IISD Global Environmental Governance Briefing Paper No. 2, International Institute for Sustainable Development, Winnipeg.

Hoffman, Matthew J. 2011. *Climate Governance at the Crossroads: Experimenting with a Global Response after Kyoto.* New York: Oxford University Press.

Homer-Dixon, Thomas. 1991. "On the Threshold: Environmental Changes as Causes of Acute Conflict." *International Security* 16 (2): 1–4.

Ibrahim, Maggie. 2005. "The Securitization of Migration: A Racial Discourse." *International Migration* 43 (5): 171.

India Online Pages. 2011. "Mumbai's Population." Accessed August 2011. http://www.indiaonlinepages.com/population/mumbai-population.html.

IPCC (Intergovernmental Panel on Climate Change). 2007. "Climate Change 2007: Synthesis Report; Summary for Policymakers." http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

Jones, Reese. 2009. "Geopolitical Boundary Narratives, the Global War on Terror and Border Fencing in India." *Transactions of the Institute of British Geographers* 34 (3): 290–304.

Khan, Md. Mobarak Hossain, Alexander Kramer, and Luise Prufer-Kramer. 2011. "Climate Change and Infectious Disease in Megacities of the Indian Subcontinent: A Literature Review." In *Health in Megacities and Urban Areas*, edited by Alexander Krämer, Mobarak Hossain Khan, and Frauke Kraas, 135–152. New York: Springer.

Leighton, Michelle. 2006. "Desertification and Migration." In *Governing Global Desertification: Linking Environmental Degradation, Poverty, and Participation*, edited by Pierre Marc Johnson, Karel Mayrand, and Marc Paquin, 43–58. Burtlington: Ashgate.

Little, Laura, and Chris Cocklin. 2009. "The Vulnerability of Urban Slum Dwellers to Global Environmental Change." In *Global Environmental Change and Human Security*, edited by Richard A. Matthew, Jon Barnett, Bryan MacDonald, and Karen L. O'Brien, 77–96. Cambridge, MA: MIT Press.

Mabey, Nick. 2009. "What Does the Security Community Need from a Global Climate Regime." E3G Briefing, November. http://www.e3g.org/images/uploads/E3G_What_does_the_Security_Community_need_from_a_Global_Climate_Regime.pdf.

Maplecroft. 2010. "Big Economies of the Future - Bangladesh, India, Philippines, Vietnam and Pakistan - Most at Risk from Climate Change." October 21. http://maplecroft.com/about/news/ccvi.html.

Munich Re Foundation. 2007. "Vulnerability in Megacities: A Case Study of Events in Mumbai and Paris." http://www.munichre-foundation.org/NR/rdonlyres/5A2170A5-FED4-47AE-B2C7-A2C6A9055B39/0/PosterWolfMumbaiandParis.pdf.

Poncelet, Alice, François Gemenne, Marco Martiniello, and Hassan Bousetta. 2010. "A Country Made for Disasters: Environmental Vulnerability and Forced Migration in Bangladesh." In *Environment, Forced Migration and Social Vulnerability*, edited by Tamer Afifi and Jill Jäger, 211–22. Berlin: Springer.

Prasad, Neeraj, Federica Ranghieri, Fatima Shah, Zoe Trohanis, Earl Kessler, and Ravi Sinha. 2009. *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters*. Washington, DC: World Bank.

Rana, Masud P. 2011. "Urbanization and Sustainability: Challenges and Strategies for Sustainable Urban Development in Bangladesh." *Environment, Development, and Sustainability* 13 (1): 237–56.

Ranger, Nicola, Stéphane Hallegatte, Sumana Bhattacharya, Murhty Bachu, Satya Priya, K. Dhore, Farhat Rafique, et al. 2011. "An Assessment of the Potential Impact of Climate Change on Flood Risk in Mumbai." *Climatic Change* 104 (1): 139–67.

Ravallion, Martin, Shaohua Chen, and Prem Sangraula. 2007. "New Evidence on the Urbanisation of Global Poverty." World Bank Policy Research Working Paper No. 4199, World Bank, Washington, DC.

Rygiel, Kim. 2010. *Globalizing Citizenship*. Vancouver: UBC Press.

Tacoli, Cecelia. 2009. "Crisis or Adaptation? Migration and Climate Change in a Context of High Mobility." *Environment and Urbanization* 21 (2): 513–25.

Warner, K., M. Hamza, A. Oliver-Smith, F. Renaud, and A. Julca. 2010. "Climate Change, Environmental Degradation and Migration." *Natural Hazards* 55 (3): 689–715.

World Health Organization. 2008. *Protecting Health from Climate Change: World Health Day 2008*. Geneva: World Health Organization.

WWF (World Wildlife Fund). 2009. *Mega-Stress for Mega-Cities: A Climate Vulnerability Ranking of Major Coastal Cities in Asia*. Gland: WWF International.