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Migration and Climate Change in Latin America and the Caribbean

Raoul Kaenzig and Etienne Piguet

Introduction

This chapter is based on existing empirical studies related to climate change and migration in Latin America and the Caribbean.[1] It looks at the situation in the region as compared with that in other regions of the world, while underscoring certain aspects that are specific to Latin America and the Caribbean. Historical analogy is used; a summary of the past consequences of environmental degradation for migration facilitates an evaluation of the future consequences of climate change. In addition, this compilation of existing studies also makes it possible to reflect critically on the geographic and theoretical distribution of the case studies and to identify the regions for which additional and complementary studies would be desirable, given the vulnerability of those regions. Based on the existing literature, three kinds of climate evolution are expected to have the greatest impact in terms of population displacement: natural hazards (tropical cyclones,[2] heavy rains and floods), droughts and sea level rise (Piguet 2008; Intergovernmental Panel on Climate Change 2007). Added to this list is the melting of glaciers, which is a particularly sensitive issue in some Andean countries. The present chapter includes an evaluation of the impact on migration of each of these phenomena based either on historical experience or on projections.

[1]The present chapter builds partly on the observations made in a previous article by the same authors on Central America and South America Kaenzig and Piguet (2011). It includes an updated look at the region and the analysis is extended to include the Caribbean.

[2]The generic term "tropical cyclone" includes hurricanes (in the western Atlantic and eastern Pacific), typhoons (in the western Pacific), cyclones (in the southern Pacific and the Indian Ocean), tropical storms, etc. For this chapter, in the particular case of Latin America and the Caribbean, the term "tropical storms and hurricanes" is used.

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The case studies that have been drawn on for this overview were chosen for their primary focus on the relationship between migration and environmental changes linked to climate. In some cases, however, studies that relate to the migratory consequences of environmental degradations that are not linked to climate change are discussed, such as earthquakes (Belcher and Bates 1983; Halliday 2006), or where the causal link with global warming is not completely established, such as El Niño events. Proceeding by analogy, the lessons that can be drawn from these studies can also shed light on the future consequences of climate change for migration. This constitutes a widely accepted hypothesis in the field of migration and in environment studies, but it should be kept in mind that climate change could lead to environmental disruptions without historical precedent and that the current trends in migration also often differ from the migrations of the past. For those reasons, historical analogies should be completed whenever possible with other methods such as scenario building or exploratory modelling. In this chapter, when the findings of the studies permit, population mobility is described according to its probable duration and the distances covered.

This chapter does not include a discussion on the consequences for migration resulting from deforestation and large-scale development and construction projects. Although these issues are at the heart of the most important challenges for Latin America and the Caribbean, the authors consider them to be distinct from the issue addressed here,[3] namely the relationship between migration and the direct impacts of climate change (natural hazards, water shortages and rising sea levels).

Current Effects of Climate Change in Latin America and the Caribbean

The large variations across the region in terms of climate, ecosystems, population distribution and lifestyles (Intergovernmental Panel on Climate Change 2007; Nagy et al. 2006) mean that climate change manifests itself in very different ways depending on the area and the type of physical phenomenon. This section includes a brief look at each of these manifestations.

Precipitation

Over the last decade, an increase in precipitation has been observed in south-eastern Brazil, in Paraguay, in Uruguay, in the Argentine Pampas and in parts of Bolivia. Meanwhile, other regions, such as southern Chile, southern Peru and western Central America, have experienced a sharp decline. This increased variability in

[3]Research on the stakes for migration related to issues of deforestation and of development projects has focused primarily on the area of the Amazon Basin, with case studies on Brazil Capellini et al. (2011), Rodrigues et al. (2009), Fearnside (2008), and on Ecuador Barbieri et al. (2008), Carr (2009). in particular.

precipitation, exacerbated by the El Niño and La Niña cycles,[4] can intensify the periods of drought,[5] leading to severe shortages in the water supply or, alternatively, can increase the intensity and/or the frequency of floods (Warner et al. 2009; Intergovernmental Panel on Climate Change 2007). These changes are particularly worrisome in Central America and in Mexico. Countries such as Guatemala, Nicaragua and Mexico are already frequently affected by periods of drought. A special report on extreme events published by the Intergovernmental Panel on Climate Change (IPCC) points out that, in addition, Central America, Mexico and north-eastern Brazil will (with a moderate amount of certainty) experience an intensification of their drought phases by the end of the twenty-first century (IPCC 2012). These episodes of drought have a major impact on the economy and on development in general because households rely almost entirely on rain-fed agriculture for their livelihoods (Adger 2006; Eakin 2005). According to the Stern Review on the Economics of Climate Change, in Latin America and the Caribbean, agriculture is the sector most affected by the increase in temperatures and in the variability of precipitation (Nagy et al. 2006).

Temperature

Latin America and the Caribbean have seen an average increase in temperatures of between 0.5 and 1 °C over the last 15 years.[6] The acceleration of the melting of glaciers is one of the most tangible consequences of this rise in temperature. The tropical glaciers have lost more than one third of their surface area in recent decades (Coudrain et al. 2005). This phenomenon is particularly worrisome in the Andean countries, such as Bolivia, Colombia, Ecuador and Peru, where access to water, whether for consumption or for hydroelectric production, already represents a serious challenge. Taking the warming into account, these problems with water supply will most likely become more severe over the years to come. According to the various climatic scenarios developed by IPCC, the region will see an increase in average temperatures of anywhere between 1 and 6 °C by 2100 (scenarios B2 and A2, respectively), with the greatest amount of warming affecting the tropical areas of South America (Intergovernmental Panel on Climate Change 2007).

[4]In an El Niño phase, the surface water temperature in the Pacific Ocean increases considerably, modifying the pressure system and causing major changes in precipitation patterns. The coastlines of South America are particularly exposed to the changes that result from the cycles of El Niño Intergovernmental Panel on Climate Change (2007).

[5]In the Amazon Basin, as well as in Central America, there has been an observable increase in changes to the patterns of the seasons. This is seen most obviously in the later start to the rainy season, which therefore also means a lengthening of the dry seasons Aguilar et al. (2005), Marengo et al. (2011).

[6]In Latin America and the Caribbean, it has not been possible to establish any long-term tendency in temperature averages. Nevertheless, one can see a significant trend toward warming in certain areas (Amazon Basin and the north-western part of South America) and, in certain rare cases, toward cooling (Chile) Intergovernmental Panel on Climate Change (2007).

Natural Hazards

The following map (Fig. 7.1) shows the number of people (in millions) affected by tropical storms and hurricanes (shown in grey) and by floods (in black) over the last 40 years. Central America and the Caribbean are clearly the regions most affected by tropical storms and hurricanes, while South America was particularly affected by floods.

Over recent decades, Central America and the Caribbean have been visited by a large number of tropical storms and hurricanes, with a record number of extreme events occurring during the 2005 season; the National Oceanic and Atmospheric

Fig. 7.1 Map of the population (in millions) affected by natural hazards (*Source:* CRED 2012)

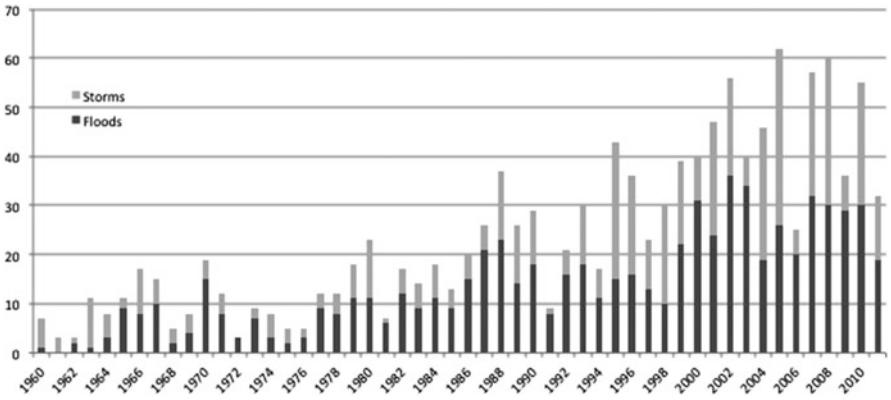

Fig. 7.2 Population (in millions) affected by tropical storms or hurricanes and by flooding in Latin America and the Caribbean, by year (*Source*: CRED 2012)

Administration[7] recorded no fewer than 31 such storms that season, of which 4 were Category 5 hurricanes. This highly unusual number of storm activities resulted in dramatic material and human losses: Hurricane Stan, for example, struck Mexico and four Central American countries (Costa Rica, El Salvador, Guatemala and Nicaragua), killing 1,500 people and causing 3 billion dollars' worth of losses (Magrin et al. 2007).

Floods and mudslides often accompany hurricanes, and this was certainly the case for Hurricane Mitch, which struck Honduras and Nicaragua in 1998 with devastating consequences, killing almost 10,000 Hondurans (Simms and Hannah 2006; Warner et al. 2009; Wrathall 2008). More recently, in September 2010, Hurricane Karl reached the coasts of Mexico and the heavy rains that it caused resulted in major flooding throughout the Veracruz region. Along the same lines, the Bahamas, Belize, El Salvador and Puerto Rico[8] are all among the top 10 countries in the world in terms of the population's exposure to coastal storms, according to Dasgupta et al. (2009). It should be noted that the first-ever hurricane to have been observed in the southern Atlantic hit southern Brazil in 2004 and was followed by major flooding in the eastern Amazon Basin (Pezza and Simmonds 2005). There were also serious floods in Argentina in 2000 and 2002, and torrential rainfall affected the Bolivarian Republic of Venezuela in 2005.

Figure 7.2 shows the steep increase in the number of people affected by tropical storms or hurricanes and by flooding over the last four decades. In fact, from 2001 to 2011, five times as many people were affected by natural catastrophes as was the case from 1960 to 1970.

[7]www.nhc.noaa.gov/2005atlan.shtml

[8]The Commonwealth of Puerto Rico is an unincorporated territory of the United States.

In this overview, one can see that, although environmental disturbances are not new to Latin America and the Caribbean, they are rapidly increasing and are very likely to become worse in the future, and this is especially so for the intensity and frequency of extreme events such as tropical storms, hurricanes and torrential rains (Magrin et al. 2007; IPCC 2012).

Migration Driven by Environmental Change

The following three sections include a summary of the empirical studies that have specifically documented the relationships between climate change and migratory processes. These sections address the three most important environmental factors that, as a result of climate change, could play an increasing role in the coming years and that may affect migration.

In the first section, the connection between environmental hazards and population displacements is analysed. As previously mentioned, the authors' primary method here is historical analogy, which draws on lessons from the past, as there are no precise forecasts available for future hydrological, meteorological or climatological catastrophes. The second section addresses the question of water shortages. Because droughts occur less abruptly than do other natural hazards, they have resulted in very different outcomes, and whether mobility is used as a response depends heavily on the context in which the exposed populations live. Particular attention is paid to the Andean regions, where retreating glaciers present a major challenge. And finally, in the third section, the occurrence of rising sea levels is addressed. In this section, there are almost no historical analogies available, but it is possible to use fairly precise projections about the populations that are threatened by this phenomenon.[9]

From Natural Catastrophes to Migration?

Tropical storms, hurricanes and floods are typical examples of phenomena that appear with very little warning and can result in the displacement of populations in search of shelter, care or food. Estimates of the number of people affected each year in Latin America and the Caribbean by floods (330 million between 2000 and 2010) and by tropical storms and hurricanes (226 million in the same period) give an idea of the magnitude of the threat (EMDAT 2012),[10] but it is very difficult to estimate how many people would be affected if there were to be more of these catastrophes due to climate change. No climatological model is capable of predicting precisely

[9]For a methodological discussion, cf. Piguet (2010).

[10]The Emergency Events Database (EM-DAT) is an international catastrophe database used as a classification system (see www.emdat.be/classification). Floods are listed as hydrological catastrophes, cyclones as meteorological catastrophes, droughts as climatological catastrophes and earthquakes as geophysical catastrophes.

where or when catastrophes will occur, and it is therefore not possible to know whether the areas affected are densely populated or not. Past experience, however, does offer a wealth of information on the kinds of displacement caused by these phenomena and on the specifics of the roles played by the phenomena themselves.

Most of the existing research on meteorological catastrophes in Latin America and the Caribbean focuses on hurricanes and tropical storms in Mexico, Central America (El Salvador, Guatemala, Honduras and Nicaragua) and the Caribbean (Dominican Republic and Haiti). There appears to be only one study that was carried out further south; and indeed such catastrophes take place much less often there. This qualitative research undertaken in Argentina as part of the Environmental Change and Forced Migration Scenarios (EACH-FOR) project,[11] comes to the conclusion that environmental risks[12] do not lead to substantial population movements, that economic reasons appear to be the main drivers of such movements (Irianni et al. 2008).

Saldaña-Zorrilla and Sandberg (2009) measured the influence of floods, storms, hurricanes, droughts and frosts on migratory phenomena in Mexico from 1990 to 2000. The results of their multivariable analyses show that, all other things being equal, an increase of 10 % in the frequency of natural disasters results in an increase of 5–13 % in migration, depending on the affected region. Studies by Alscher and Faist (2008) and Escobar et al. (2006) confirm that, in the Chiapas region, Hurricane Mitch (1998) and Hurricane Stan (2005) were triggers among economically vulnerable populations for the decision to migrate. Wrathall's study (2008) offers a refinement of this result, affirming that, among vulnerable populations, the most economically disadvantaged often resort to migrating within their country.

Research carried out in Nicaragua and in Honduras, also on the consequences of Hurricane Mitch for migration, reach similar conclusions. In Nicaragua, the results of a study carried out before and after the hurricane indicate that the households that were most exposed to torrential rainfall during the hurricane had a greater inclination to migrate abroad than did households with similar adaptive capacities but living in an unexposed region (Carvajal and Pereira 2008). In Honduras, Oliver-Smith (2009) significant increase in the number of arrests of migrants along the American-Mexican border in the months following the hurricane. These studies, however, also highlight the crucial importance of the social context, because these population displacements are occurring in regions that have been rendered fragile by their great social, environmental and economic vulnerability. As Comfort states in Oliver-Smith: "The uprooted people of Honduras were not refugees of nature, but were displaced by socially inscribed and enacted changes in their environment that combined with a naturally formed agent called a hurricane" (2009:19). The hurricane, then, in aggravating the precariousness of the situation, acts as a catalysing element that can result in the decision to migrate.

[11]See www.each-for.eu

[12]The study considers floods, cyclones, earthquakes and soil erosion.

Though Halliday's study (2006) focuses not on climate deterioration but on migration between El Salvador and the United States of America as a result of earthquakes[13] and agricultural misfortunes,[14] is of great interest as an analogy because it provides some nuance for the results discussed immediately above. This study is based on information gathered over several different periods (longitudinal research undertaken with panel studies). The statistical analyses show that, while unfavourable agricultural conditions significantly increase migration to the United States, the sudden events studied, namely the earthquakes, have the opposite effect, with a 40 % decrease in departures. Belcher and Bates (1983) obtained similar results in their study of two earthquake episodes, one in 1972 in Nicaragua and one in 1976 in Guatemala. They also observed that emigration from the affected communities was no greater than emigration from unaffected areas. From this, the authors conclude that the incidences of migration cannot be directly attributed to the earthquakes but that they must be seen within their specific local contexts. In Chile, for example, in spite of the dire material consequences of the 2010 earthquake, the resulting population displacements were of short duration, essentially for the purpose of dealing with the immediate needs of the situation (André 2011). In some cases, net migration can even turn out to be positive (more immigration than emigration) after such an event because of the increased need for human resources to help with reconstruction in the affected areas. This phenomenon was observed in Brazil in early 2011, when violent rains resulted in landslides and flooding in the state of Rio de Janeiro (Capellini et al. 2011).

In the Caribbean, Haiti is often cited as a case in point in studies on the vulnerability of populations to sudden environmental damage. In Haiti, almost all the forests have disappeared and a large proportion of the country is subject to serious soil erosion, which exacerbates the consequences of the tropical storms or hurricanes and the floods that strike the island, threatening the population's means of subsistence (Alscher 2011; Simms and Hannah 2006). According to Jacobson (1988), the first references to Haitian boat people as "environmental refugees" go back to 1984. The environmentalist Myers evokes the fundamental role that environmental damage plays on the island, stating that Haitians "are abandoning their homeland in part because their country has become an environmental basket case" (Myers 1993). Nevertheless, the existing empirical studies (using qualitative methods and/or literature reviews) allow for the conclusion that migratory processes continue to be deeply motivated by factors related to the political and economic order. At the same time, the studies also stress that environmental factors also significantly weaken the sometimes precarious situation in Haiti (Alscher 2011; Leighton-Schwartz and Notini 1995; Catanese 1999; Barker 1989). Along these lines, after the 2010 earthquake in Haiti, the humanitarian conditions and the

[13]Earthquakes are not a result of climate warming, but some of the consequences of earthquakes are similar to the consequences of hurricanes and other climate-related catastrophes and some analogies can therefore be drawn with them.

[14]Halliday defines agricultural misfortunes as "agricultural conditions that caused livestock loss and/or harvest loss" Halliday (2006).

authorities' inability to respond to the urban population's basic needs, in particular, drove city dwellers to return to the country's rural areas, thereby endangering the resident population's food security along with that of the new arrivals. The overexploitation of natural resources had previously led the inhabitants of the rural areas to leave those regions. The International Organization for Migration (IOM) (2012) estimates that 1.5 million people were subject to internal displacement after the earthquake.[15] Others migrated abroad, mostly to the countries of Latin America or the Caribbean, while attempts to emigrate to the United States were severely limited by the increased enforcement of migration policies and the high cost of the trip (Gütermann and Schneider 2011).

It becomes clear that Central America has been the object of much more research than has the Caribbean region, which, despite having had to face intense and repeated natural catastrophes, has not been very well documented. There is research on environmental degradation processes, but most of these studies do not include information about the stakes for migration. Looking at the island of Hispaniola (Dominican Republic and Haiti), however, it is very clear that the effects of tropical storms or hurricanes and of floods are greatly exacerbated by the high degree of deforestation and soil erosion. This fragile environmental context makes the region very vulnerable to natural hazards, thereby exposing the population to greater risks than would otherwise be the case.

The tropical storms and hurricanes that have hit Central America have had a somewhat different impact on migration from that which can be observed elsewhere in the world. In Central America, migration appears to be more often international than what has been underlined in studies about other regions of the world. It is possible to assume that the proximity of the United States as a migration destination, along with migrants' greater economic resources (partly thanks to remittances from earlier migrants), may explain this difference. In addition, migration is most often seen in contexts in which there are pre-existing relationships of migration between the sending and receiving regions (Deprez 2010). However, it should be kept in mind that local and temporary displacements are still a common characteristic. As in Asia, a large part of the affected populations in Central America do not have the means to move far and soon return to the disaster area to rebuild their homes (Paul 2005).

Nevertheless, the situation in Latin America and the Caribbean shares many features with what studies have shown in the rest of the world. For example, as emphasized by Kniveton et al. (2008), the level of vulnerability differs greatly from one region to another, and social and economic contexts also play important roles. In Latin America and the Caribbean as anywhere else, in order for significant and long-lasting migration to occur, the society must be largely dependent on the environment for its survival and social factors must also exacerbate the impact of the catastrophe.

[15] At the end of 2011, half of a million people were still staying in temporary camps. The population that remains in the camps is the most vulnerable. When the camps were established, 60 % of their residents were homeowners (of their previous residence) and 40 % were not. By the end of 2011, the non-homeowners made up 80 % of the population that were still living in the camps (IOM 2012).

Migration and Water Shortages

Existing research on the global scale shows that shortages of water for human consumption and for irrigation occur much less suddenly than do tropical storms or hurricanes and floods. As a result, the kinds of mobility caused by water shortages are more gradual, especially in rural regions (Leighton 2011). Far from always representing a tragedy in itself, the resulting migration, in such a context, can be the basis of a diversification of revenue sources for coping with decreased agricultural productivity, revenues and means of subsistence (Bilsborrow 1992).

The existing empirical studies in this field are very mixed, and it is difficult to weigh the importance of specifically environmental factors. Many researchers argue against a direct link between drought and emigration, insisting instead on the multiplicity of causes, on the variety of survival strategies adopted by the affected populations, and on the fact that the displacements caused by water scarcity and desertification are essentially moves over short distances (Kniveton et al. 2008; Leighton 2011; Meze-Hausken 2004).

In Brazil, the north-eastern part of the country is particularly affected by a high incidence of droughts.[16] This semi-arid region relies mainly on agriculture made up of small subsistence farms, and historical studies have shown that, during periods of drought, the region can suffer agricultural losses that are as high as 80 % of production, resulting in waves of emigration to more favourable regions, in the south of the country (Kahn and Campus 1992; Capellini et al. 2011). Leighton estimates that droughts were contributing factors in the emigration of 3.4 million people between 1960 and 1980 (Leighton 2006). More recently, Franke et al.(2002) show the effect of the El Niño fluctuations of the early 1980s and early 1990s on migration from rural regions to the cities of São Luís and Teresina (the capitals of their respective states). Confalonieri (2003) also establishes a correlation between the 1982–1983 El Niño period and the peaks that were observed in migration between the states of Maranhão and Pará. However, these studies do not allow a determination about whether these migrants were part of particularly vulnerable populations, with little financial or social capital, who were forced to move, or whether, instead, this was the migration of a relatively well-off population for whom migration was a strategic choice (Barbieri et al. 2010; Barbieri and Confalonieri 2011).[17]

[16]Capellini et al. (2011), who are critical of the determinist point of view, point out that drought episodes in north-eastern Brazil are exacerbated, maybe sometimes even caused, by the concentration of property and by the fact that water resources are managed by powerful landowners.

[17]It is also worth noting that these same authors developed an original approach for the purpose of estimating the impact of climate change on migration using a comprehensive economic model based on the warming scenarios of IPCC and applied to north-eastern Brazil. Their very interesting findings are, however, still exploratory. They seem to indicate a weak impact of climate change on migration, with, however, an increase in migration beginning in the 2030s. Barbieri et al. (2010), Barbieri and Confalonieri (2011).

There are two studies focusing on Ecuador. The research of Alvarez Gila et al. (2008) addresses Ecuadorian immigrants living in Spain. The interviews that they carried out show that the immigrants considered that mostly economic factors had caused their departure, but that environmental degradation (mainly soil erosion and desertification, often attributed to El Niño episodes) accentuated the difficulties. Therefore, the authors of those studies see these forms of mobility as alternatives that make it possible for the population to deal with environmental hazards. Gray (2009) carried out a study of 300 households in Ecuador between 1995 and 2006, examining the explanatory factors at work in migratory processes at the local, regional and international levels. Some of the environmental variables that were used included precipitation and changes in the volume of agricultural production.[18] The results show that environmental conditions play a role in migration at all three geographic levels, but that they are more significant for local and regional mobility.

Balderrama Mariscal et al. (2011) look at the characteristics of migration in the Bolivian Andes,[19] which is an area that has been particularly affected by gradual environmental degradations such as drought and desertification. Internal migration (to other rural regions or to neighbouring cities, which constitute major population magnets) has long been a revenue diversification strategy for communities that are dependent on agriculture. In the northern part of the administrative region of Potosi, households with agricultural holdings above 3,500 m adopt temporary or seasonal forms of migration, while the communities in the valleys, between 1,650 and 3,000 m, who are severely affected by processes of degradation and of soil erosion, tend to leave the area for good. Nevertheless, it is still difficult to weigh the influence of environmental factors here, since they are strongly connected to the general economic situation of the region, which suffers from a very high unemployment rate due to the decline of some of the mining sectors. This case study, however, does make it possible to note the way in which environmental changes affect the duration of internal migration.

Due to its sheer volume, migration between Mexico and the United States occupies a unique place in the field of Latin American migration.[20] From an environmental standpoint, 70 % of the surface area of Mexico is considered arid, and it suffers from advanced desertification, along with repeated periods of drought, especially in the northern and central regions of the country (Leighton 2006). For rural communities that are mainly dependent on rain-fed agriculture, internal or cross-border migration is therefore one of the options for dealing with adverse climatic conditions (Cohen et al. 2012).

[18]Gray refers to these changes as “unusual harvests” (Gray 2009).

[19]The study examines two regions in Bolivia: one in the Andes, in the northern zone of the Potosi Department, made up of the provinces of Ibañez, Bustillo, Bilbao, Charcas and Chayanta, and one on lower ground, in the municipality of San Julían, north-east of Santa Cruz, in the Santa Cruz Department. For the purposes of this chapter, the first of these two cases is of particular interest because in the study of the second, the environmental component is only weakly represented.

[20]Migrants originally from Latin America and the Caribbean currently make up 53 % of the total foreign-born population of the United States. Mexicans alone make up 30 % of this group (Hanson and McIntosh 2009; IOM 2011; Durand and Massey 2010).

The first set of results from the studies outlined in this chapter confirms the link among episodes of drought, processes of desertification and cross-border migration. Feng et al. (2010) show that a reduction of 10 % in crop yields that is attributable mainly to periods of drought leads to an increase of 2 % in Mexican emigration to the United States. Although they are methodologically controversial (Auffhammer and Vincent 2012), these results confirm Munshi's analyses, which also measure a negative correlation between the inclination to migrate to the United States and the rainfall levels in the region of origin in Mexico (2003). Likewise, according to the re-search of Alscher and Faist (2008), environmental degradations such as soil erosion and changes in precipitation patterns represent explanatory factors for heavy internal migration and also for emigration to the United States. These degradations come on top of economic and structural difficulties such as the liberalization of markets, increased international competition and reductions in state subsidies (Jungehülsing 2010; Alscher and Faist 2008) and are exacerbated by poor soil management (de Janvry et al. 1997; Schwartz Leighton and Notini 1994; Escobar et al. 2006).

This result, showing a relatively clear link between drought and emigration to the United States, is nuanced by the studies of Kniveton et al. (2008) and Schmidt-Verkerk (2009). The work of Kniveton et al. on the Mexican states of Zacatecas and Durango, which suffered periods of drought between 1951 and 1991, shows no significant correlation between drought and emigration in Zacatecas. On the contrary, a correlation between an increase in emigration and periods of increased rainfall can be seen in Durango (Kniveton et al. 2008).[21] Meanwhile, Schmidt-Verkerk's 2009 qualitative study, also on Zacatecas, shows that emigration is considered an option only by populations living in regions with an already-established tradition of migration. Environmental degradation, therefore, does not overturn existing practices but rather reinforces them. Migration is not an option for certain particularly vulnerable populations that have no tradition of migration, and those populations are forced to cope with environmental hazards where they are.

Andean Region and Retreating Glaciers

The retreating of the glaciers is one of the most tangible manifestations of global warming in South America. Although the physical dynamics behind the melting of the ice are quite well understood, and the media are keenly interested in the phenomenon of the melting, it has been only marginally addressed in studies that deal with migration. This subsection will therefore provide a brief summary of this specific topic.

[21]In order to explain this inverted relationship, the authors refer to the work of Findley (1994) and her case study on Mali, where she shows that long-distance migration tends to decrease during periods of drought. When experiencing water shortages, the affected households cannot afford the investment required for a long-distance migration because basic needs, such as securing a food supply, must be met first.

Since 1970, the Andean glaciers have lost almost half of their area, and the melting process has been significantly accelerating over time (Coudrain et al. 2005; Soruco et al. 2009). In Bolivia, for example, many small low- and medium-altitude tropical glaciers have completely disappeared over this period, and projections indicate that many others are likely to disappear over the coming decades (Vergara 2005; Ramirez 2006; Inter-American Institute 2010). The decreasing water supply is one of the major effects that have already been observed in the region; run-off from glacier basins is an essential element in the water supply for agriculture, drinking water, energy production and ecosystem integrity (Hoffmann 2008; Vergara 2005; Paz Rada 2007; Viviroli et al. 2007). The disruption of this supply due to global warming presents serious challenges in terms of adaptation. Migration to nearby urban centres, such as La Paz and El Alto, constitutes a common revenue-diversification strategy in the mountain regions' rural communities. While this form of mobility, which is often temporary, allows subsistence-farming households to be less dependent on their unpredictable environmental context, it also exposes them to the market's price fluctuations (Kaenzig 2011; McDowell and Hess 2012).

Other ethnographic studies have also addressed this issue (Rhoades 2008; Orlove 2009; Carey 2010; Young and Lipton 2006), providing valuable insights into the ways in which communities living along the edges of the retreating glaciers, especially in the mountainous areas of Ecuador and Peru, have adapted. However, even though these studies sometimes refer to migration as an inescapable consequence of the melting of the glaciers, they do not specifically analyse the relationship. At the same time, this very relationship – between the melting of the glaciers and migration – has been the basis for numerous discussions, many of them alarmist, in the international media and in reports[22] by non-governmental organizations, international organizations and governments, although no scientific study has rigorously documented the mechanisms connecting the retreat of the glaciers with migration in South America. At present, then, research on the implications of glacier melting for migration, and more generally of climate change in the Andes, would appear to be highly desirable. In particular, the focus should be put on urban areas (for example, La Paz, El Alto, Lima and Quito), as they are often important destinations, but also extremely vulnerable to climate change.

The present overview of the studies that examine droughts and, to a lesser extent, glacier retreat, confirms that these phenomena are connected, sometimes strongly, with migration phenomena. Yet the results are inconsistent from one study to the next, which can be explained by the lack of reliable and consistent data on migration and precipitation but, even more so, by the variability of local contexts and of the adaptation strategies of different populations. In conclusion, migration represents one possible form of adaptation among several, while at the same time it is not available to everyone. Therefore, it would be going too far to predict that, as water resources decrease, there will be an inevitable increase in migration.

[22]See especially Vergara (2005), OXFAM (2009) and Ross (2010).

Table 7.1 Population (in millions) living at or below an altitude of 1, 5 and 10 m above sea level

Sea-level rise: Authors and regions studied	1 m	5 m	10 m
Nicholls (2004), Latin America and the Caribbean	9	–	–
Anthoff et al. (2006), Latin America and the Caribbean	9.9	17	24.7
Dasgupta et al. (2007), Latin America and the Caribbean	2.9	13.5	–
McGranahan et al. (2007), Latin America and small island States, including the Caribbean	–	–	35

Sea-Level Rise: A Long-Term Factor for Migration

Unlike natural catastrophes and droughts, which are context-specific and sometimes temporary, the rise in sea levels is unequivocally linked with migration. It is a practically irreversible phenomenon that manifests itself in a more-or-less linear way over a long period of time. In the absence of new infrastructure, such as dikes and raised structures, sea-level rise will make migration unavoidable, while allowing for gradual, planned departures. The consequences of rising sea levels can be predicted and localized with some degree of confidence, given that the configuration, altitude and population of the coasts are known. As a result, it is possible to calculate on the global scale the number of people living in areas threatened by rising sea levels, high tides, high-amplitude waves, increased salinity or coastal erosion. McGranahan et al. (2007) estimate that, worldwide, 602 million people live at altitudes of less than 10 m. Relatively speaking, the effect would not be as great in Latin America and the Caribbean as in other regions, because the number there is only 29 million, whereas in Asia it is 466 million. Nevertheless, as Table 7.1 shows, estimates of the population–altitude intersection are still quite variable. At an elevation of 1 m, estimates range from 2.9 million to 9.9 million people affected, and at 10 m, they range from 24.7 to 35 million people.[23] (On the other hand, estimates of the number of people living at or below 5 m above sea level are relatively consistent, coming out to an average of 15 million people affected.)

The areas along Latin America's Atlantic coast as well as the Caribbean are the most exposed to the risks of flooding and increased salinity. This is especially true for the Gulf of Mexico and the Caribbean Sea, as well as the mouths of large rivers such as the Amazon in Brazil, the Orinoco in the Bolivarian Republic of Venezuela and the Parana between Argentina and Uruguay. Even some inland areas, such as the Argentine Pampas, may also be affected by flooding as rising sea levels weaken natural drainage systems (Vergara 2005). On the Pacific coast, Ecuador is the only country that is significantly at risk (Anthoff et al. 2006).

[23] One explanation for this large degree of variation has to do with the data sources used; although all of the studies use the same population data, no two use the same data for altitude. According to Farr and Kobrick (2000), determining the areas that are at or below 10 m above sea level is still very difficult, especially in regions with steep coasts.

In terms of surface area, urban zones make up a very small part of the areas at risk of flooding (8 % of the total floodable area)[24]; the at-risk regions are mostly made up of agricultural land and humid and marshy areas. On the other hand, from the point of view of the affected population, the areas at risk are mostly in urban or densely populated regions (of people living in at-risk areas, 77 % live in cities).[25] In all likelihood, the population of the coastal urban zones will continue to grow in the coming years (Black et al. 2011).

Assuming a scenario in which sea levels rise by 1 m, the populations of Suriname, Guyana and the Bahamas, would feel the greatest impact, with somewhere between 5 and 7 % of the total population being affected, followed by French Guyana and Puerto Rico (Dasgupta et al. 2007; MacGranahan et al. 2007). IPCC also notes that island States are particularly vulnerable, with little ability to withstand the effects of climate change. Environmental damage caused by rising sea levels could also harm biodiversity, fisheries, tourism and infrastructure (Nagy et al. 2006). Jamaica's situation is similar to that of other small island States in that beach erosion, coral bleaching, salinization of drinking water and intense tropical storms can significantly hurt tourism. According to Berringer (2012), a decline in the tourism industry would have adverse effects on the country's poverty level, which may provide a further incentive to migrate abroad to places where the diaspora is already well established, such as the United Kingdom, the United States or Canada.

The habitable areas of the Caribbean islands are densely populated, with high growth rates, especially in urban areas (Intergovernmental Panel on Climate Change 2007). For the island countries of the Caribbean, rising sea levels put forward the sensitive issue of the possible disappearance of a State. In an article on the issue of climate-driven statelessness, however, Piguet (2012) points out that, among the Member States of the Alliance of Small Island States, not one of the three States with a maximum altitude of under 10 m[26] is in the Caribbean. In fact, among the Caribbean States, only the Bahamas has a highest point lower than 100 m (its highest point is at 63 m), but the country's overall topography, as well as its resources for establishing protective measures, means that disappearance would be very unlikely.

In conclusion, rising sea levels probably constitute the most clearly threatening aspect of climate change in terms of the global effect on forced long-term migration. Although rising sea levels affect Latin America and the Caribbean in a less significant way than they do other regions, there are nevertheless large areas that are at risk and, even beyond the issue of possible habitat loss, economic activities are also in danger, and their loss could force migration as well. Tourism and fishing are the two most vulnerable activities, especially in the Caribbean. In addition,

[24]Based on the data given in McGranahan et al. (2007) and Dasgupta et al. (2007); in both cases, the result is the same.

[25]Based on the data given in McGranahan et al. (2007).

[26]The three States are the Maldives (300,000 inhabitants; maximum altitude of 2 m), Tuvalu (10,000 inhabitants; maximum altitude of 2 m) and the Marshall Islands (63,000 inhabitants; maximum altitude of 6 m). Piguet (2012).

responses to rising sea levels involve more than just the simple abandonment of land, and migration can occur long before the living space is truly uninhabitable. The context, again, becomes highly relevant, as the affected populations may develop context-specific adaptive or mitigating strategies that could allow them to either significantly delay or, alternatively, significantly advance the need to leave.

Conclusions: A Region Highly at Risk Yet Very Little Studied

This overview shows, first of all, how few empirical studies there still are with respect to the consequences of climate change or of environmental catastrophes for migration in Latin America and the Caribbean (there appear to be just over 20 such studies) and how unevenly they are distributed across the region. There are many more studies on Central America, and particularly on Mexico, and a certain number that deal with Brazil. On the other hand, aside from Ecuador, the Andean countries (that is to say, Bolivia, the Bolivarian Republic of Venezuela, Chile, Colombia and Peru), along with South America's north-eastern countries (French Guyana, Guyana and Suriname) have remained relatively unexplored. The effects of climate change and of environmental damage in the Caribbean have certainly been noted, especially in the media, but there has been very little research that also includes the issue of migration. As far as tropical storms and hurricanes are concerned, the frequency with which they occur could partially explain the greater interest in Central America, but that does not apply to other phenomena, such as flooding, the increased variability in precipitation and the melting of the glaciers, which affect many countries.

There are three hypotheses about why it is that these areas have been studied so unequally. The first has to do with the existence, or lack thereof, of local research centres on migration and, where such centres do exist, how widely their findings are disseminated in international journals, especially English-language ones, which play a dominant role in the international scientific landscape. The second hypothesis has to do with pre-established relationships of migration with the United States, which have so far clearly dictated the scientific research agenda. Thus, Mexico, with its strong history of emigration to the United States, has been the object of a large volume of research carried out by North American researchers. And finally, interest in migrant-sending countries can be explained by political motives having to do with the politics of migration and security. The widespread fear surrounding uncontrollable flows of "climate refugees," fleeing their countries to seek shelter in northern countries, has prompted the rich countries to intensify research in potential migrant-sending areas. One extreme example is the report "Climate change and immigration: Warnings for America's southern border," which attempts to analyse the "migration risk" for the United States posed by climate change in Latin America (Ross 2010). The complexity of the phenomena involved, as illustrated in the present chapter, shows the degree to which such concerns are based on simplistic ideas about the relationship between migration and the environment.

Table 7.2 Summary of the identified consequences for migration based on the type of effect of climate change

Effects of climate change	Consequences for migration
Natural hazards (hurricanes, storms and floods)	Mostly in Central America and the Caribbean: the observed resulting mobility is generally local, and a tendency to return has often been observed. When there is international migration, the United States is the main destination.
Water shortages	Many areas are very vulnerable. So far, there has been little proven impact on mobility. There have been documented cases of migration from Mexico to the United States but the mechanisms are particularly complex and context-specific, with multiple causes.
Rising sea levels	No migration observed at present, but the areas identified as being at risk are highly populated and often urban. Without heavy protective measures, migration will in some cases be inevitable in the medium term.

A second conclusion is that the relationship between environmental change and migration that can be observed in Latin America and the Caribbean confirms the main tendencies that have been noted in other parts of the world: most displacements take place over short distances, with urban centres having a strong attraction; and in the case of sudden catastrophes, displacements are often short-term. The strategies used to cope with environmental changes include leaving and returning, temporary stays and multiple residences. Rather than speaking of migration, let alone of "refugees," it would make sense in these cases to discuss mobility and "displaced persons." In addition, the findings of these studies on Latin America and the Caribbean confirm that displacements related to the environment are multi-causal and therefore also very context-specific. The same kind of disturbance will have completely different consequences depending on the economic, social and political situation in which it occurs. And finally, environmentally driven displacements, which must be considered within their historical context, occur most frequently where there are pre-existing relationships of migration between the sending and receiving countries. Treating migration as an inevitable consequence of climate change, as well as trying to quantify the number of future migrants based on a simple count of the population living in the threatened areas, is therefore a misleading simplification. "Roots of flight: Environmental refugees in Latin America," an article published in 1996, already then pointed out that the forced displacements that were attributed to environmental factors should instead be seen as the result of a colonial past that had resulted in many conflicts over the unequal distribution of land and property (Gosine 1996). This analysis, rooted in a post-colonial perspective, is yet another reminder that environmental damage is often just one more factor added to social and political contexts that are sometimes steeped in deep inequality. The current legitimate interest in the consequences of climate change should not mean that the power dynamics that shape the social realities of the regions being studied are forgotten (Table 7.2).

In summary, Latin America and the Caribbean, although very vulnerable to climate change, should not be considered as a special case as far as past environmentally driven migration is concerned. The effects of climate change on population displacements in those areas should therefore not be radically different from its effects on population displacements as observed elsewhere. There should be relatively little long-distance migration in response to hurricanes and droughts but existing migration channels will most likely be strengthened, and there is a significant potential for long-term displacement due to rising sea levels. However, certain effects of climate change on migration specific to South America can be seen. This is the case with the melting of the tropical glaciers, which has not yet been greatly studied. These results provide a strong argument for increased research into the complex interactions between migration and the environment, especially in the most vulnerable countries.

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