

Climate and Migration: A Synthesis

Etienne Piguet

1 Introduction

The concern of the international community about the consequences for migration of climate change has been growing since the publication in 1990 of the first UN intergovernmental report on climate change stating 'The gravest effects of climate change may be those on human migration as millions will be displaced' (Intergovernmental Panel on Climate Change (IPCC-1), 1990: 20). In 1993, the projection by Norman Myers of 150 million environmental refugees by the end of the twenty-first century and his statement that 'the issue of environmental refugees (...) promises to rank as one of the foremost human crises of our times' further fuelled the fear of mass migrations (Myers, 1993; Myers, 1997: 175; Myers, 2002). Ten years later, Sir Nicholas Stern wrote in his review delivered to the British government on the economic consequences of global warming that: 'Greater resource scarcity, desertification, risks of droughts and floods, and rising sea levels could drive many millions of people to migrate' (Stern, 2006: 111). These gloomy predictions had a tremendous effect in the media: Filmmaker Roland Emmerich dramatised the fear of climate migration in 2004, in a scene from the film 'The Day after Tomorrow' where American citizens flee en masse from a terrible climatic disturbance from the north, only to find themselves ironically running up against the fences of the American–Mexican frontier. In 2005, Papua New Guinea appeared on the front page of the British newspaper *The Guardian* in a leading article entitled 'The First Refugees of Global Warming', announcing the decision to progressively evacuate all one thousand inhabitants of the small atoll of Carteret (Kilinailau) that was being slowly submerged by rising seas.

Notwithstanding the present media focus, the amount of systematic research on migration and climate change remains quite limited. There is

E. Piguet (✉)

Institute of Geography, University of Neuchâtel, Neuchâtel, Switzerland
e-mail: Etienne.piguet@unine.ch

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much vagueness surrounding the concepts employed, the underlying mechanisms involved, the number of persons affected and the geographical zones concerned. The use of the term 'refugee' by numerous authors has also led to certain confusion. It evokes the juridical status recognised by the UN Convention of 1951 referring to any person leaving his country of residence while having a 'well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion', although it is clear that environmental motives are absent from this list and that most displacements happen internally, within internationally recognised borders.

This chapter first tries to understand why the environmental aspect of the study of migration and refugees has been neglected up until now. It then concentrates on climate aspects by providing a synthesis of existing empirical results followed by projections of future developments.

2 A Historically Documented but Neglected Topic of Study

The links between climate and human migrations are of course not new, and population geography has, for many years, acknowledged the role played by environmental factors in explaining the history of civilisations and the emergence of cities. Thus, for mankind, the passage across the Bering Straits from America 13,000 years ago was possible due to the low sea levels of the Ice Age. According to certain authors cited by Brown (2008: 21), the Barbarian invasions of Europe around the fourth century had climatic causes as well as the Muslim expansion in southern Europe. In the same vein, the Medieval Climate Optimum which lasted between the eighth and thirteenth centuries AD allowed the colonisation of Greenland by the Vikings (Bell and Walker, 2005), and inversely, the Little Ice Age which followed forced them to leave the area. According to Le Roy Ladurie, it also led to famine migration in Northern Germany where groups of beggars fleeing bad crops were described in Magdeburg, Mayence and Lübeck in 1316/1317 (Le Roy Ladurie, 2004). Paradoxically, it also appears that drought had a positive impact on the rise of civilisations. Thus, the desertification of the Sahara and the Arabian peninsula has played an important part in the densification of the population on the banks of the Nile and consequently contributed to the birth of ancient Egyptian civilisation (Hammer, 2004: 238).

In modern times, the summer heat of 1845 and 1846 in Ireland stimulated *fungus infestans* and destroyed the potato crops, leading to the famous famine emigration towards England, the USA, Canada and Australia (Le Roy Ladurie, 2004). Similarly, the droughts of the 1930s in the plains of the American Dust Bowl forced hundreds of thousands of migrants towards California (McLeman et al., 2008), and those that

struck the Sahel between 1969 and 1974 displaced millions of farmers and nomads towards the cities (Hammer, 2004). More generally, the strong link between precipitation and population density has been shown in the American Great Plains (Robinson et al., 1961), and Barrios et al. (2006) recently stated in a study of 78 countries over a 30-year period that climatic change, as proxied by rainfall, has acted significantly to change urbanisation in sub-Saharan Africa (although not elsewhere in the developing world).

With industrialisation and tertiarisation, however, the importance of the role given by population geographers and other researchers to the environment declined progressively. Already at the end of the nineteenth century, the famous 'migration laws' of E.G. Ravenstein held that economic factors were of prime importance. Their pre-eminence was almost exclusive in the theorisation of migration flows during the second half of the twentieth century (Massey et al., 1993). While certain environmental characteristics of areas studied were taken into consideration, generally, only the positive factors received any serious attention. In this respect Greenwood (1969) highlights the favourable effect of high average temperatures on internal migration in the US mainland, while Graves (1980) measures the effect of climate mildness in general on migration. Up until recently, the environment, especially when considered as a negative factor inducing forced displacements, has been absent from the study of migration on account of the dominance of what we can call an 'Economic Paradigm'. One can add that migrations linked to the environment are frequently internal and affect Southern countries. It is noteworthy that these two aspects of migration have been neglected by researchers to the advantage of studies of international migrations to Northern countries. A similar result stems from the 'Political Paradigm' that characterises the specific study of refugees (Refugee Studies). The latter give only limited attention to the link between environment and migration and often focus on political refugees as defined under the 1951 UN Convention. Consequently, it is not surprising that surveys of refugee studies only give very limited attention to environmental aspects, except for the degradation that refugees might cause themselves (Black and Robinson, 1993; Richmond, 1988; Zolberg et al., 1986).

As a result of these two paradigms among social scientists, one can note with Massey et al. (2007: 3) that in none of the disciplines of social sciences 'environmental conditions figure as salient determinants of migration decision-making' while at the same time 'many environmentalists take as an article of faith that population growth, environmental deterioration, and out-migration are fundamentally interrelated'. What is true for the impact of the environment in general holds true for the impact of climate and led to important controversy among scholars during recent years.

3 A Problematic and Controversial Concept

The term 'Environmental refugees' was popularised in 1985 as a report title for the United Nations Environment Program (El-Hinnawi, 1985).¹ It has since been widely diffused in not only both political and academic circles but has also been severely criticised (Black, 2001; Castles, 2002). Rightly highlighting the shaky empirical character and sloppy nature of most work on the subject, the critics have brought to the fore problems arising from a unidirectional link between environmental changes and migrations. For Castles 'The term environmental refugee is simplistic, one-sided and misleading. It implies a monocausality which very rarely exists in practice (...) [Environmental and natural factors] are part of a complex pattern of multiple causality, in which [they] are closely linked to economic, social and political ones.' (Castles, 2002: 5). Numerous works confirm this: when environmental deteriorations cause displacements, they are often the by-product of economic, demographic or political factors (Hugo, 1996). Moreover, vicious circle phenomena are frequent and it is not easy to isolate primary causes. Hence, population displacements will induce environmental problems that might have an effect on conflicts which themselves could exacerbate environmental deterioration, etc. (Hagmann, 2005; Reuveny, 2007). There is agreement today that natural factors are not the sole cause of migration and that the economic, social and political situation of the zone under threat can, depending on the case, increase or decrease the flow of migrants.

Another serious criticism has been addressed to the advocates of the environmental refugee concept and, in particular, to Norman Myers and his estimation of a potential 150 million refugees. They are accused of brandishing the spectre of a flood of migrants towards rich countries, thus reinforcing the position of governments having policies of closed borders who are hostile to refugees. For MacGregor (1993: 162): 'In so far as the term environmental refugee conflates the idea of disaster victim and refugee, its use brings with it the danger that the key features of refugee protection could be undermined and the lowest common denominator adopted. Because environmental can imply a sphere outside politics, use of the term environmental refugee may encourage receiving states to treat the term in the same way as economic migrants to reduce their responsibility to protect and assist.' Apart from the scientific error of oversimplifying the processes taking place, the danger here is also one of 'evacuating political responsibility by overplaying the hand of nature' (Cambrézy, 2001: 48).

Even if they might have dampened the enthusiasm of certain researchers, reservations regarding the concept of environmental refugees seem to be fully justified. They have obliged the scientific community to be mindful of the consequences of their choices of terminology and point to the need for clear definitions of the different aspects of the phenomenon. A considerable number

¹ See Kniveton et al. (2008: 29) for the complete genealogy of the term.

of terminological variants have indeed been used by researchers to refer to persons fleeing climate hazards, and more generally, environmental disturbances. While the term *environmental refugees* – sometimes *ecological refugees* or even *envirogees* (Thill, 2008) – is frequent in the English language (El-Hinnawi, 1985; Jacobson, 1988; Myers, 1993; Myers, 1997; Westing, 1992) during the 1990s, as well as in German *Umweltflüchtling* (Bächler, 1994; Richter, 1998) and in French *Réfugiés de l'environnement* (Gonin and Lassailly-Jacob, 2002), one observes the emergence of a more general terminology such as *environmental* or *ecological migrants*, *ecomigrants* or *ecomigrations* (Wood, 2001) or the acronyms EIPM (Environmentally Induced Population Movements) and EDP (Environmentally displaced person). In order to differentiate more precisely the nature of environmental degradation on the one hand, and the type of assistance needed on the other, Renaud et al. (2007) proposed a typology of environmental migrant crossing vulnerability and type of degradation.

Targeting more precisely *climate change migrants*, the International Organization for Migration proposes to define them as: 'Persons or groups of persons who, for compelling reasons of sudden or progressive change in the environment as a result of climate change that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad' (Kniveton et al., 2008: 31). This definition is well suited to designate a category of migration in an unambiguous way vis-à-vis the 1951 Convention, but – as we shall see in the following section – it might give the climate a nearly deterministic status of *deus ex machina* which is not confirmed in empirical research on migration.

4 Global Warming, Natural Disasters and the Progressive Evolution of the Environment

It is extremely difficult to elaborate any scientific predictions concerning the number of *environmental or climate migrants*. This is due to the multicausality of the process of migration (Boano et al., 2007) and due to the impossibility of combining climate and migration mathematical models (Perch-Nielsen, 2004; Perch-Nielsen, Bättig and Imboden, 2008). A historically informed prospective method seems more promising: the expected consequences of climate change are enumerated first, so as to establish an estimation of the populations most at risk. As pointed out by Castles (2002) and contrary to a common implicit hypotheses of numerous Cassandras of climate change migration, being at risk does not necessarily mean having to migrate. On this basis, the past experiences of similar natural events have to be documented in order to assess the proportion of the victims who might migrate temporarily or permanently over a short or long distance.

Three consequences of climate warming, projected for the end of the twenty-first century in the latest report of the IPCC, appear to be the most threatening potential causes of migration (IPCC, 2007):

- The increase in strength of tropical hurricanes and in the frequency of heavy rains and flooding due to the augmentation of evaporation correlative to temperature increase;
- The growth in the number of droughts, with evaporation contributing to a decrease in soil humidity, often associated with food shortages;
- The increase in sea levels resulting from both water expansion and melting ice.

While the first two consequences are manifested in sudden natural disasters, the third is a long-term process, which, as we will see, has very different possible implications in terms of migration. We leave aside other effects of global warming on health, conflicts or the viability of certain economic activities that may have additional consequences for migration but which remain subject to speculation.

5 Past Experiences of Natural Hazards and Migration

5.1 Hurricanes, Torrential Rains and Floods

The consequences of hurricanes and floods on population displacement are among the easiest to identify in that they manifest themselves in a brutal and direct manner. While we know approximately the number of persons affected by flooding worldwide (106 million, on average, between 2000 and 2005; according to the International Disaster Database), and by hurricanes (38 million; according to the same source), the total number of people threatened by a potential increase of this kind of disaster is, however, very difficult to estimate. No climate model is able to predict with accuracy whether or not the affected zones will be densely populated and whether the damage wrought will have tragic consequences. Apart from this methodological difficulty of forecasting, the studies carried out after such events tend to relativise their effects in terms of migration in general and long-term/long-distance migration in particular. Living mainly in poor countries, the victims have little mobility (Lonergan, 1998) and the majority of the displaced return as soon as possible to reconstruct their homes in the disaster zone (Kliot, 2004). The results from numerous research projects conducted worldwide tend to confirm this point with remarkable regularity. Thus, a synthesis of results on migration choices of victims of natural disasters displaced in 18 sites confirms – with rare exceptions – the strong propensity to return (Burton et al., 1993). In a much more indirect and incomplete fashion, studies on persons seeking asylum in Europe indicate no correlation between asylum applications and natural disasters recorded in the zones of departure. On the contrary, a significant link is confirmed regarding the political situation in these same zones (Neumayer, 2005).

On a global level, the general conclusion is thus that the potential of hurricanes and torrential rains to provoke long-term and long-distance migrations remains limited. As pointed out by Kniveton et al. (2008: 35), it is only if the affected society is highly dependent on the environment for livelihood and if

human action exacerbates the environmental aspect of the disaster – as was the case with Hurricane Katrina (Reuveny, 2008) – that significant migration takes place. The level of vulnerability can be tremendously different from one region to another.

5.2 Drought and Desertification

In the recent past, the number of persons affected by drought has been comparable to that of victims of hurricanes and floods (146 million people, on average, between 2000 and 2005 according to the International Disaster Database). The latest report of the IPCC projects increased water shortages in Africa (74–250 million people affected in 2020) and Asia: ‘Freshwater availability in Central, South, East and Southeast Asia, particularly in large river basins, is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s.’ (IPCC, 2007: 10). Case studies, however, bring to light a contrasted picture of the consequences for migration of these kinds of change. The effect of a lack of drinking and irrigation water on migration is actually less sudden than that of the meteorological events mentioned in the previous section, and it only generates progressive departures.

On one hand, there are many well-known cases of mass population departures, in particular not only in Africa (Sahel, Ethiopia) but also in South America (Argentina, Brazil), in the Middle East (Syria, Iran), in Central Asia and in Southern Asia. Hammer (2004: 232) presents an impressive table of forced migration due to droughts and floods during the period 1973–1999 in the Sahel with a maximum of 1 million displaced persons during the drought in Niger in 1985. He affirms, ‘It seems very likely that hundreds of thousands of people from rural Sahel regions are displaced every year as a consequence of environmental change and desertification’ (Hammer, 2004: 234). Likewise, for Leighton (2006: 47), ‘The periodic drought and desertification plaguing north-east Brazil contributed to factors causing 3.4 million people to emigrate between 1960 and 1980.’

On the other hand, many researchers strongly relativise the possible direct link existing between drought and emigration by highlighting the fact that the latter, in general, is the last resort when all other survival strategies have been exhausted. Consequently, during the 1994 drought in Bangladesh, only 0.4% of households had to resort to emigration (Smith, 2001). Other researchers hold similar views to those of the Nobel Prize winner for Economics, Amartya Sen, in remarking that famines are, in general, only marginally the direct result of environmental factors, but much more of political ones (Sen, 1981) and add that this also holds for migration. A multivariate analysis on interprovincial migrations in Burkina Faso thus shows that environmental variables, in general, only explain 5% of migrations and drought itself only 0.8% (Henry et al., 2003). In

certain contexts, the effect can even be the inverse. This was the case in Mali during the drought of the mid-1980s: a reduction in international emigration was observed due to the lack of available means to finance the journey (Findley, 1994). For Kniveton et al. (2008: 34), 'Drought seems to cause an increase in the number of people who engage in short-term rural to rural types of migration. On the other hand, it does not affect, or even decrease international, long-distance moves. Second, the conceptualization of drought-affected as helpless victims who are left with no choice but to flee seems to be false.'

The general conclusion to be drawn here is that projections of increased migrations linked to drought-related phenomena remain hazardous. Consequently, it would be difficult to put a figure on the magnitude of populations at risk and the potential migrations arising from global warming-induced droughts.

5.3 Rising Sea Levels

While the first two climatic hazards mentioned do not foreshadow massive population displacements due to climate change, the potential for migration when linked to an increase in sea level is considerable. In contrast to hurricanes, floods and droughts, this phenomenon is virtually irreversible and manifests itself over a long period of time. This could make migration the only possible option for the population affected as exemplified by the historical analogue of Holland Island (Arenstam Gibbons and Nicholls, 2006). The localisation of the consequences of rising sea levels is a relatively easy task, because the configuration of coastlines, their altitude and population is well known and thus easy to integrate into Geographical Information Systems (GIS) that permit simulations and projections. Hence, it is possible to calculate – on a global scale – the number of persons living in low elevation coastal zones and threatened by rising water levels, higher tides or further-reaching waves. MacGranahan et al. (2007) define 'Low elevation coastal zones' as being situated at an altitude of less than 10 m. Even though these zones only account for 2.2% of dry land, they presently are home to 10.5% of the world population, some 602 million people of which 438 million live in Asia and 246 million in the poorest countries of the world. Other authors furnish slightly lower figures totalling 397 million people, but these, nevertheless, remain impressive (Anthoff et al., 2006).

It would be certainly an exaggeration, however, to consider that these hundreds of millions of people are all potential migrants in the near future. The latest report of the IPCC evokes, of course, the possible melting of the Greenland ice cover and the consequent 7-m rise in sea level, but this would occur over several thousand years. Of more concern to us here is the scenario of thermal expansion of the oceans. According to a future CO₂ emission estimate based on continuing economic growth but with a moderation of fossil fuel use (scenario A1B of the IPCC), there could be an increase of 0.3–0.8 m of the sea

level by 2300 (IPCC, 2007). On this basis, it seems reasonable to consider populations living at an altitude of less than 1 m as being directly vulnerable during the next century. A study commissioned within the framework of the Stern report gives a considerable figure of 146 million people for this group (Anthoff et al., 2006). Mainly situated in the major river deltas and estuaries, the flood zones are particularly populated in South Asia (Indus, Ganges-Brahmaputra, etc.) and East Asia (Mekong, Yangtze, Pearl River, etc.). These two regions account for 75% of the population at risk. Certain Pacific states, such as Tuvalu or Kiribati, are – in the short-term – among the most threatened, as they are situated only centimetres above sea level. Although far less populated, they have several thousand inhabitants.

The increase in sea levels appears to be the aspect of global warming that represents the greatest direct threat for numerous populations. Contrary to hurricanes and droughts, the localisation of potential victims is possible. If no mitigation measures are taken and if no effort is made to protect the groups at risk, they will have no alternative but to emigrate.

6 Conclusion

Existing research shows that due to the number of factors involved, no climatic or environmental hazards inevitably result in migrations. Many authors note that even if disasters become more frequent in the future, political efforts and measures of protection will be able to lessen the need to emigrate, provided that the necessary financial means are made available. Even rising sea levels could be partially counteracted by the erection of dykes or the filling in of threatened zones. The Stern report is clear in this respect and states that ‘The exact number who will actually be displaced or forced to migrate will depend on the level of investment, planning and resources’ (Stern, 2006: 112). It nevertheless estimates these costs of mitigation to be many billion dollars.

This overview also shows that the very concept of *climate* or *environmental refugee*, because of its connotations of urgency and unavoidability, is to be handled with care. It actually evokes fantasies of uncontrollable waves of migration that run the risk of stoking xenophobic reactions or serving as justification for generalised policies of restriction for people seeking asylum. As recently stated by Massey et al. (2007: 22): ‘[one] should evince considerable caution in viewing “environmental refugees” as a major component of migratory streams around the world. For the most part, environmental deterioration appears to promote local searches for organic inputs or alternative employment opportunities, not a desperate search for relief in distant lands.’

At the same time, this summary clearly shows that environmental degradation can generate substantial migration flows and that global warming, in particular, could lead to major forced displacements. The latter would result principally from rising sea levels but would only progressively manifest themselves over the coming centuries with the exception of the flooding of certain

islands. The increase in droughts and meteorological disasters projected by climatic models will also have impacts in terms of migration, but these will remain regional and short-termed, and are at present difficult to estimate.

The question of the international system of protection needed in order to face these challenges is thus to be answered and is all the more important because of the clear responsibility of rich countries for global warming. Simply including environmental motives in the 1951 definition of refugees seems politically unfeasible due to the very likely opposition of receiving countries. It would probably not achieve its objective of protection, as the majority of displacements takes place inside the countries affected. It would also risk threatening the coherence of an international framework of refugee protection that already has difficulty in obliging states to respect their commitments. The United Nations High Commissioner for Refugees (UNHCR), being very aware of this risk of confusion between political and non-political refugees, has always treated the idea of broadening the scope of the Convention to include environmental migrants with the utmost prudence, even if he also deems this category of the population as a possible part of his protective mandate towards Internally Displaced Persons (IDP) within states (UNHCR, 2008). As stated in 2005 by the then Under Secretary General of the UN, Hans van Ginkel, 'This is a highly complex issue, with global organizations already overwhelmed by the demands of the conventionally-recognized refugees as originally defined in 1951. We should prepare now, however, to define, accept and accommodate this new breed of refugee within an international framework' (United Nations University, 2005).

It seems that two possibilities can be envisaged with regard to this: On one hand, an increased international cooperation with a view to collective burden sharing of assistance and prevention in countries confronted with disasters, and on the other, the opening of emigration channels with the recognition of environmental push factors in subsidiary international instruments of protection, such as temporary protection schemes. This second option seems more viable for urgent cases but brings with it numerous problems, in particular the question of responsibility for the displacement of the person from the disaster zone to the receiving zone.

The discussion of these possible solutions is largely beyond the scope of this essay, but it is evident that without firm preventative action, global warming could have serious consequences in terms of forced migrations. This must be more widely recognised and stimulate scientific and political awareness.

References

- Anthoff, D., P. Nicholls, R.S. Tol, and A. Vafeidis (2006): Global and regional exposure to large rises in sea-level: A sensitivity analysis. *Tyndall Centre for Climate Change Research – Working Paper 96*.
- Arenstam Gibbons, S.J., and R.J. Nicholls. (2006): Island abandonment and sea-level rise: An historical analog from the Chesapeake Bay, USA. *Global Environmental Change* 16(1), 40–47.
- Bächler, G. (1994): *Umweltflüchtlinge: das Konfliktpotential von morgen? = Environmental refugees: A potential of future conflicts?* Agenda Verl, Münster.

- Barrios, S., L. Bertinelli, and E. Strobl. (2006): Climatic change and rural–urban migration: The case of sub-Saharan Africa. *Journal of Urban Economics* 60(3), 357–371.
- Bell, M., and M.J.C. Walker. (2005): *Late Quaternary Environmental Change: Physical and Human Perspectives*. Prentice Hall.
- Black, R. (2001): Environmental refugees: Myth or reality? *Perspectives New Issues in Refugee Research – UNHCR Research Paper No. 34*.
- Black, R., and V. Robinson. (1993): *Geography and Refugees*. Belhaven, London.
- Boano, C., R. Zetter, and T. Morris. (2007): *Environmentally Displaced People: Understanding the Linkages between Environmental Change, Livelihood and Forces Migration*. Refugee Studies Center, Oxford.
- Brown, O. (2008): Migration and climate change. *International Organization for Migration – Migration Research Series 31*, Geneva.
- Burton, I., R.W. Kates, and G.F. White. (1993): *The Environment as Hazard*. Guilford Press, New York, NY.
- Cambrézy, L. (2001): *Réfugiés et exilés – crise des sociétés – crise des territoires*. Editions des Archives Contemporaines, Paris.
- Castles, S. (2002): Environmental change and forced migration: Making sense of the debate. *New Issues in Refugee Research – UNHCR Research Paper No. 70*.
- El-Hinnawi, E. (1985): *Environmental Refugees*. United Nations Environmental Program, Nairobi.
- Findley, S.E. (1994): Does drought increase migration? A study of migration from rural Mali during the 1983–1985 drought. *International Migration Review* 28(3), 539–553.
- Gonin, P., and V. Lassailly-Jacob. (2002): Les réfugiés de l’environnement. Une nouvelle catégorie de migrants forcés? *Revue Européenne des Migrations Internationales* 18(2), 139–160.
- Graves, P.E. (1980): Migration and climate. *Journal of Regional Science* 20(2), 227–237.
- Greenwood, M.J. (1969): An analysis of the determinants of geographic labor mobility in the United States. *Review of Economics and Statistics* (51), 189–194.
- Hagmann, T. (2005): Confronting the concept of environmentally induced conflict. *Peace, Conflict and Development* 6(6), 1–22.
- Hammer, T. (2004): Desertification and migration: A political ecology of environmental migration in West Africa. In: Unruh, J.D., Krol, M.S., and Kliot, N. (ed.), *Environmental Change and Its Implications for Population Migration*. Kluwer, Dordrecht.
- Henry, S., P. Boyle, and E.F. Lambin. (2003): Modelling inter-provincial migration in Burkina Faso: The role of socio-demographic and environmental factors. *Applied Geography* 23(2–3), 115–136.
- Hugo, G. (1996): Environmental concerns and international migration. *International Migration Review* 30(1), 105–131.
- Intergovernmental Panel on Climate Change. (2007): *Climate Change 2007: The Physical Science Basis – Summary for Policymakers*. IPCC – Secretariat, Geneva.
- Intergovernmental Panel on Climate Change (IPCC-1). (1990): Policymakers’ summary of the potential impacts of climate change. *Report from Working Group II to IPCC*.
- International Disaster Database. EM-DAT – OFDA/CRED – Université Catholique de Louvain, Brussels, Belgium. Available from <http://www.emdat.be>. 1 October, 2008.
- Jacobson, J. (1988): Environmental refugees: A yardstick for habitability. *Worldwatch Paper – Washington DC No. 86*.
- Kliot, N. (2004): Environmentally induced population movements: Their complex sources and consequences – A critical review. In: Unruh, J.D., Krol, M.S., and Kliot, N. (ed.), *Environmental Change and Its Implications for Population Migration*. Kluwer, Dordrecht.
- Kniveton, D., K. Schmidt-Verkerk, C. Smith, and R. Black (2008): Climate change and migration: Improving methodologies to estimate flows. *International Organization for Migration – Migration Research Series 33*, Geneva.
- Le Roy Ladurie, E. (2004): *Histoire humaine et comparée du climat*. Fayard, Paris.

- Leighton, M. (2006): Desertification and migration. In: Johnson, P.M., Mayrand, K., and Paquin, M. (ed.), *Governing Global Desertification*. Ashgate, London. pp. 43–58.
- Loneragan, S. (1998): The role of environmental degradation in population displacement. *Environmental Change and Security Project Report* (4), 5–15.
- Mac Gregor, J. (1993): Refugees and the environment. In: Black, R., and Robinson, V. (ed.), *Geography and Refugees. Patterns and Processes of Change*. Belhaven, London. pp. 157–170.
- MacGranahan, G., D. Balk, and B. Anderson. (2007): The rising tide: Assessing the risks of climate change and human settlements in low elevation coastal zones. *Environment and Urbanization* 19(17), 17–37.
- Massey, D.S. et al. (1993): Theories of international migration: A review and appraisal. *Population and Development Review* 19(3), 431–466.
- Massey, D.S., W.G. Axinn, and D.J. Ghimire (2007): Environmental change and out-migration: Evidence from Nepal. *Population Studies Center Research Report No. 07-615*.
- McLeman, R., D. Mayo, E. Strebeck, and B. Smit. (2008): Drought adaptation in rural eastern Oklahoma in the 1930s: Lessons for climate change adaptation research. *Mitigation and Adaptation Strategies for Global Change* 13(4), 379–400.
- Myers, N. (1993): Environmental refugees in a globally warmed world. *Bioscience* (43), 752–761.
- Myers, N. (1997): Environmental refugees. *Population and Environment* 19(2), 167–182.
- Myers, N. (2002): Environmental refugees: A growing phenomenon of the 21st century. *Philosophical Transactions: Biological Sciences* 357, 1420.
- Neumayer, E. (2005): Bogus Refugees? The determinants of asylum migration to Western Europe. *International Studies Quarterly* 49(3), 389–410.
- Perch-Nielsen, S. (2004): Understanding the effect of climate change on human migration – The contribution of mathematical and conceptual models. *Diploma Thesis – Department of Environmental Sciences ETH – Zurich*.
- Perch-Nielsen, S., M.B. Bättig, and D. Imboden. (2008): Exploring the link between climate change and migration. *Climatic Change* vol. in print.
- Renaud, F., J.J. Bogardi, O. Dun, and K. Warner. (2007): Control, adapt or flee how to face environmental migration? *InterSecTions 'Interdisciplinary Security ConnecTions' Publication Series of UNU-EHS* 5.
- Reuveny, R. (2007): Climate change-induced migration and violent conflict. *Political Geography* 26(6), 656–673.
- Reuveny, R. (2008): Ecomigration and violent conflict: Case studies and public policy implications contact information. *Human Ecology* 36(1), 1–13.
- Richmond, A.H. (1988): Sociological theories of international migration: The Case of Refugees. *Current Sociology* 36(2), 7–25.
- Richter, R.E. (1998): Umweltflüchtlinge in Afrika. In: Scheffran, J., and Vogt, W.R. (ed.), *Kampf um die Natur*. Darmstadt. pp. 42–73.
- Robinson, A., J. Lindbergh, and L. Brinkman. (1961): A correlation and regression analysis applied to rural farm population densities in the Great Plains. *Annals of the Association of American Geographers* 51, 211–221.
- Sen, A.K. (1981): *Poverty and Famines: An Essay on Entitlement and Deprivation*. Clarendon Press, Oxford.
- Smith, K. (2001): *Environmental Hazards, Assessing the Risk and Reducing Disaster*. Routledge, London.
- Stern, N. (2006): *The Stern Review on the Economic Effects of Climate Change (Report to the British Government)*. HM Treasury – Retrieved from www.sternreview.org.uk
- Thill, S. (2008): Climate destruction will produce millions of 'Envirogees'. *Alternet*. <http://www.alternet.org/environment/86285/?page=1> – visited 27th June 2008. no. May 27.

- UNHCR. (2008): *Climate change, environmental degradation, natural disasters and human displacement: UNHCR's preliminary observations (second draft)*. The Office of the United Nations High Commissioner for Refugees (mimeo), Geneva.
- United Nations University. (2005): As ranks of "Environmental Refugees" swell worldwide, calls grow for better definition, recognition, support. *11 October 2005 – Press Release – UNU Institute for Environment and Human Security* no. Retrieved on 27 July, 2007. Available from <http://www.ehs.unu.edu/article:130>.
- Westing, A.H. (1992): Environmental refugees: A growing category of displaced persons. *Environmental Conservation* 19(3), 201–207.
- Wood, W.B. (2001): Ecomigration: Linkages between environmental change and migration. In: Zolberg, A., and Benda, P.M. (ed.), *Global Migrants Global Refugees – Problems and Solutions*. Berghahn, New York, NY. pp. 42–61.
- Zolberg, A.R., A. Suhrke, and S. Arguayo. (1986): International factors in the formation of refugee movements. *International Migration Review* 20(2), 151–169.