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Climate change-induced migration and violent conflict

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Abstract

In a world of rising sea levels and melting glaciers, climate change is most likely occurring but with uncertain overall effects. I argue that we can predict the effects of climate change on migration by exploring the effects of environmental problems on migration in recent decades. People can adapt to these problems by staying in place and doing nothing, staying in place and mitigating the problems, or leaving the affected areas. The choice between these options will depend on the extent of problems and mitigation capabilities. People living in lesser developed countries may be more likely to leave affected areas, which may cause conflict in receiving areas. My findings support this theory, and suggest certain policy implications for climate change.

Keywords: Climate change; Migration; Conflict

Introduction

Scholars predict that climate change will degrade the environment considerably during this century, *ceteris paribus* (IPCC, 2007a, 2007b). What are the implications of this prediction for human migration and violent conflict, defined as a range of activities, including, for example, threats, beating, appropriation, insurgency, skirmishes, and interstate or intrastate wars? Gleditsch, Nordås, and Salehyan (2007) observe that climate change-induced migration appears in many climate change-to-violence scenarios. They argue that whether these scenarios will materialize depends on the scope of degradation and the extent it influences migration

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decisions, calling for more research in this area. To streamline the discussion, I use the term "conflict" hereafter to denote "violent conflict".

My goal is to contribute to the body of knowledge on the climate change–migration–conflict nexus. Recognizing that the effects of climate change are not yet fully manifested, I believe we can gain insight by exploring past effects on migration induced by environmental problems of the type climate change is expected to cause, and effects this migration had on conflict. I refer to this migration as "environmental migration".

I argue that people can adapt to environmental problems in three ways: stay in place and do nothing, accepting the costs; stay in place and mitigate changes; or leave affected areas. The choice between these options depends on the extent of the problems and mitigation capabilities. Developed countries (DCs) are likely to mitigate problems through technological innovation and institutional redesign. Less developed countries (LDCs) are less likely to mitigate such problems since they lack wealth and expertise. Facing severe environmental problems, people in LDCs may have to leave affected areas, which, in turn, may cause conflict in receiving areas due to several reasons. I explore this theory empirically by investigating certain global environmental changes, effects of natural disasters, and patterns across many environmental migration episodes. I find that severe environmental problems play a role in causing migration, which, at times, leads to conflict in receiving areas.

What are the implications for addressing climate change? While caution is needed when empirical findings are employed for prediction, scholars typically assume that when analyses explain historical data, they provide important information for the future. My findings suggest if climate change causes severe environmental degradation, many people may leave affected areas, particularly in LDCs, which may lead to conflict between migrants and residents in receiving areas. Policymakers may mitigate this outcome *if* they take initiative early on. The next two sections provide the theoretical basis for the empirical analyses that follow.

Climate change-induced migration

In the 20th century, there have been consistent patterns indicative of climate change. For example, since the 1950s, average global temperature rose by about 0.1 °C per decade, winter snow covers declined by 10%, Northern ice thickness fell by 40%, the frequencies and intensities of droughts, storms, and warm periods rose, glaciers retreated, and the sea level rose by 20 cm. Scholars attribute these changes to increased carbon emissions from fossil fuel burning. Assuming business as usual, these problems are expected to intensify (IPCC, 2007a, 2007b).

Climate change is generally expected to hit LDCs harder than DCs (IPCC, 2001, 2007b). Key concerns in LDCs include serious threats to food security and health, considerable economic decline, inundation of coastal areas, and degradation of land and freshwater resources. Key concerns in DCs are generally less extreme (e.g., coastal erosion, tourism decline, higher insurance costs). LDCs are also less able to mitigate or adapt to these problems than DCs due to their poverty, low level of technological advancement, and high dependence on the environment for subsistence.

What implications does climate change bring for migration and conflict? Hirschman's (1970) economic framework provides a useful starting point. Facing a decline in product quality, people may stop buying the product (denoted as exit), consume the product but call to improve its quality (voice), or do nothing (loyalty). People are less likely to exit when they have no substitutes or when loyalty is high. Some scholars employed this framework for non-environmental migration, associating loyalty and voice with staying in place and exit with migration (e.g., Colomer, 2000); I

employ it for environmental migration. Facing severe environmental degradation due to climate change, people can mitigate the effects (voice), do nothing and accept a lower quality of life (loyalty), or leave the affected areas (exit). Choosing to exit may lead to conflict in receiving areas. Predicting whether conflict will occur requires associating expected environmental changes with topographical features, dependence on the environment for livelihood, weather patterns, resource availability, population density, order structures, and sociopolitical fault lines. This complex task is not done here. Alternatively, one could gain insights by studying effects on migration in recent decades resulting from environmental problems of the type climate change is expected to cause, and the role of this migration in receiving area-conflict.

My premise is that individuals decide to migrate if the net benefit (total benefit minus total cost) from migrating is larger than that from not migrating. Facing several possible destinations within and outside their countries, they choose the one that provides the largest net benefit. This model faces two problems. First, it assumes that people *choose* whether to migrate. Though people facing threats to their lives, including environmental threats, are, in a way, *forced* to migrate, migration is truly involuntary only if people are expelled; even people facing such threats can choose not to leave, hoping to survive. Second, the model does not distinguish between intrastate and interstate movements despite the different constraints they entail. In this article, however, the issue is what drives migration, not its destination.

Standard migration literature classifies forces considered by migrants as network, pull, and push forces (e.g., Borjas, 1994; Martin & Widgren, 2002): network forces affect the move from location A to location B, push forces operate in A and push people to leave A, and pull forces operate in B and attract people to B. Economic and sociopolitical network forces include forms of various aids. Economic push forces include high unemployment, economic decline, and underdevelopment, while pull forces include employment, prosperity, and development (e.g., Karemera, Oguledo, & Davis, 2000). Sociopolitical push forces include wars and persecution, while pull forces include peace, family unification, and presence of brethren (e.g., Moore & Shellman, 2006).

I argue that environmental problems also play a role in migration. Some problems involve extreme weather events, which, so far, have tended to be idiosyncratic and localized. Other problems include accumulating changes such as rising sea levels, land degradation, and declining freshwater resources, which tend to exert relatively more permanent and dispersed effects. Underdeveloped societies are at high risk for such problems, particularly if they depend on the environment for livelihood; their voice will be ineffective in bringing about mitigation efforts. Such societies are relatively more likely than developed societies to exit the affected area, particularly when their loyalty is low, as is perhaps the case in LDCs whose borders were carved by colonial powers.

As an example, land degradation and scarcity have been growing in Bangladesh (East Pakistan before 1971) since the 1950s. Poor and dependent on agriculture, many Bangladeshis became less able to make a living. Frequent storms, floods, and droughts made things worse. Largely due to these forces, 12–17 million Bangladeshis moved to India, and half a million moved internally (e.g., Homer-Dixon, 1999; Lee, 2001; Swain, 1996). As a second example, in the 1930s, strong winds, a prolonged drought, and aggressive soil tilling produced many large dust storms in the US Great Plains. As farm output and the quality of life fell, about 2.5 million people left the region (e.g., PBS, 2002; Worster, 1979).

From climate change-induced migration to conflict

This section argues that climate change-induced migration can promote conflict in areas receiving migrants, the intensity of which may vary across cases. The process leading from

migration to conflict works through four channels, which may act concurrently. In this conceptual model, conflict is more likely when two or more of the following channels work together facing certain auxiliary conditions.

Competition

The arrival of environmental migrants can burden the economic and resource base of the receiving area, promoting native–migrant contest over resources. Pressures are expected to rise with the number of migrants and residents, particularly when resources are scarce in the receiving area and property rights are underdeveloped. The excess demand for resources may also generate lateral pressure, expansion of economic and political activities beyond the region's or state's borders in order to acquire resources, which increases the risk of conflict.

Ethnic tension

When environmental migrants and residents belong to different ethnic groups, the migration may promote tension. Residents may feel threatened, host countries may fear separatism, migrants may attempt to reunify with their home country, and residents may respond aggressively. Situations involving long-standing ethnic disputes between migrants and residents are likely to be particularly prone to conflict.

Distrust

Environmental migration may generate distrust between the area of the migration's origin and host area. For example, the migrants' origin country may suspect that the receiving country accepts migrants in order to upset the ethnic balance in the origin. The receiving government may suspect that the origin seeks to penetrate the host, while the origin side may resent actual or perceived mistreatment of migrants by the receiving side.

Fault lines

The conflict may also follow existing socioeconomic fault lines. For example, migrant pastoralists and resident farmers may compete over land, or migrants and residents may compete over jobs. Additionally, migration from rural to urban areas – another fault line – presents competing effects. Rebels may mobilize poor and frustrated rural migrants to challenge the state, which may respond with force. However, urban settings may offer migrants more opportunities, defusing tensions.

Auxiliary conditions

Whereas developed economies can absorb migrants in various sectors, underdeveloped economies, reliant on the environment for survival, are limited in this regard, particularly if their resources are scarce. Therefore, they are more prone to conflict due to the arrival of environmental migrants. Political instability and civil strife in the receiving area also increase the likelihood of conflict. For example, migrants may join antagonizing groups or intensify the violence through any of the above channels.

It is apparent that the logic of this model applies to both climate change-induced and ordinary migration. What sets the former migration apart from the latter is its scope and speed. When migration flows are small and slow, migrants can be absorbed more smoothly, lessening the likelihood of conflict. Thus far, climate change has induced slow changes, but its effects are expected to include evermore frequent and intense droughts and storms. Quick changes of this type can push many to migrate quickly, especially when they depend on the environment for livelihood. In this case, the forces promoting conflict in the receiving area may be stronger, *ceteris paribus*. It should also be recalled that while causation in this model flows from migration to conflict, conflict itself can promote migration, including that from the receiving area itself. This causal effect is not discussed here.

Taking a broader view, my theory has a Malthusian flavor. Recently, several observers revived the Malthusian paradigm, arguing that environmental problems cause conflict, particularly in LDCs. However, as discussed by Barnett and Adger (2007) and Nordås and Gleditsch (forthcoming), the issue is debated. Some scholars argue that these problems are not severe or that human ingenuity and innovation can alleviate them. Others argue that it is resource abundance that causes conflict, not scarcity. These criticisms notwithstanding, as Diehl and Gleditsch (1998, 2001), Gleditsch (1997), McLaughlin Mitchell (2006) and others show, many scholars agree that environmental problems make conflict significantly more likely.

That said, I do not argue that climate change-induced migration *must* lead to conflicts in receiving areas. In fact, migration can benefit absorbing areas in several ways, including increasing the workforce and tax-base, which can reduce the risk of conflict. As Gleditsch et al. (2007) note, governments may also assist in integrating migrants into society, providing, for example, financial aid, and alleviating distrust. However, we should not overrule the possibility of conflict. For example, the arrival of Bangladeshi environmental migrants in India led to violence in the 1980s (Homer-Dixon, 1999; Kalbag, 1983). Tensions between internal migrants and residents in Bangladesh turned into an insurgency in the 1980s and 1990s (Lee, 2001; Shelley, 1992). The absorption of the US Great Plains migrants in the 1930s was generally peaceful, but in California the migrants faced ugly slurs, beatings, and discrimination, their shacks were burned, and policemen were sent to block their entry to the state (Gregory, 1989; Worster, 1979). In a more extreme example, the arrival of environmental migrants from El Salvador in Honduras eventually led to a war in 1969 between the two countries (Durham, 1979).

Patterns of environmental problems

My theory underlines the importance of environmental problems induced by climate change and the dependence of people on the environment for livelihood. Since climate change is still not fully manifested, one can gain empirical insights by surveying problems involving arable land, freshwater, forests, and weather-related natural disasters. These four forces are chosen because they are important for life and climate change will likely cause problems in them. Arable land per capita is correlated with food availability, deforestation promotes flooding and land degradation and reduces freshwater availability, freshwater is a crucial resource, and disasters devastate people and properties.

Many LDCs already face problems concerning these forces. The smallest amounts of arable land per capita are in Africa and Asia, particularly East Asia, South Asia, the Middle East, North Africa, and sub-Saharan Africa (AAAS, 2000; WDI, 2002). About 1.1 billion people in the world lack access to drinkable water, including about half the population in sub-Saharan

Africa, one third in East Asia, three tenths in Southeast Asia and the Pacific, and a fifth in Latin America, South Asia, and the Middle East (HDR, 2000). In recent decades, the highest rate of deforestation was in Africa (0.8% per year), with Asia and South America trailing close behind (FAO, 2001; WR, 1999). Interpreting data from CRED (2002), in 1975–2001 Africa had the largest number of droughts (254), followed by Asia and Latin America. The largest number of floods occurred in Asia (737), followed by Latin America and Africa. Asia also had the largest number of windstorms (726), followed by North America and Europe, with Latin America trailing close behind.

My argument that regions depending relatively more on the environment for livelihood are more likely to exhibit environmental migration suggests the need to consider the role of agriculture for livelihood. The shares of the total labor force employed in agriculture in 2000 were 58% in Africa, 51% in Asia, 24% in Central America, 18% in Oceania, 14% in South America, 8.6% in Europe, and 6% in North America, reaching as high as 66% and 58.5% in some parts of Africa and South Asia, respectively (FAO, 2002).

Next, the migration examples of Bangladesh and the US Great Plains, and an additional example of migration resulting from the 2005 Hurricane Katrina in the US, suggest that people leave areas hit by intense weather-related disasters. These examples are important here because climate change is expected to raise the intensity and frequency of such disasters. Systematic data on the numbers of people migrating from areas hit by natural disasters are not available. I can suggest the scope of this phenomenon by using data from CRED (2002) on the total number of people internally displaced, made homeless, or in need of medical help, food, shelter, or water due to a disaster. Our examples suggest that some of these people may become migrants.

Using CRED (2002) data to compute total numbers of people affected by all the natural disasters of a certain type in 1975–2001, I find droughts affected about 1.1 billion people in Asia, 222 million in Africa, 48 million in Latin America, 9 million in Oceania, 6 million in Europe, and 30,000 people in North America. Floods affected about 2.1 billion people in Asia, followed by Latin America (40 million), Africa (29 million), Europe (8 million), North America (800,000), and Oceania (500,000). Windstorms affected about 416 million people in Asia, followed by Latin America (22 million), Africa (9 million), Europe (8 million), Oceania (6 million), and North America (3 million).

These figures do not distinguish disasters by strength. The key issue is not how strong a disaster is per se, but rather how strong it is relative to the ability of people to withstand it. A sparsely populated region with large freshwater reservoirs, for example, will suffer relatively less from a drought than a densely populated region without reservoirs, *ceteris paribus*. Data on the strengths of disasters are not available on a systematic basis, but we can gain insight by computing the number of people affected on average in a period by one disaster of some type. This measure suggests that in 1975–2001 the most intense droughts were in Asia, where one drought affected on average about 9.4 million people, followed by Africa (870,000), Latin America (720,000), Oceania (390,000), Europe (270,000), and North America (2500). On average, one flood affected 2.9 million people in Asia, followed by Latin America (110,000), Africa (93,000), North America (8500), and Oceania (7100). One windstorm affected on average about 570,000 people in Asia, followed by Latin America (100,000), Africa (87,000), Europe and Oceania (34,000 each), and North America (8600).

In sum, in recent decades Asia, Africa, and Latin America have both faced the most intense environmental problems and depended the most on the environment for livelihood. We thus expect that environmental migration will be relatively more prevalent in these regions.

Patterns of environmental migration and conflict

This section assembles a sample of environmental migration episodes and explores their patterns. My sample includes all the episodes for which I found data. Since I select cases based on the dependent variable, focusing on environmental migration, my findings may not apply to all migration flows. However, this is not a concern here since I only seek to study environmental migration, not ordinary migration.

Table 1 presents 38 cases of environmental migration. For each case, I list key non-environmental push factors, as well as several sources.[1] When numbers of migrants vary across these sources, I present the highest number, providing an upper limit. As noted, conflict in the receiving area may also reflect non-migration forces. In Rwanda, for example, scholars argue Hutus came to resent Tutsis because the pro-Tutsi Belgian colonial policies made the Tutsis richer than the Hutus, making Rwanda more susceptible to conflict. However, scholars acknowledge that had it not been for the environmental problems, Rwanda would have been more resilient to this tension (e.g., Kane, 1995a, 1995b). Consequently, for cases involving conflict, I list also key auxiliary conditions in the receiving area. The conflict intensity is classified broadly in four levels: (1) low – mostly unarmed, non-state violence; (2) medium – semi-organized, semi-armed, non-state violence; (3) high – intrastate insurgency, interstate skirmishes, or inter-communal, armed violence; and (4) very high – intrastate or interstate war.

Turning to the findings, 36 of the cases presented occurred in LDCs and 2 in DCs. Geographically, 15 cases occurred in Africa, 12 in Asia, 8 in Latin America, 2 in North America, and 1 in Russia. This pattern mimics the above-mentioned regional patterns of environmental problems, dependence on the environment for livelihood, and numbers of people affected by natural disasters in absolute and relative terms. Regions that exhibit more environmental problems and depend more heavily on the environment for livelihood also exhibit more environmental migration episodes.

Table 1 suggests that environmental migration is pushed by several environmental factors acting concurrently. Land degradation is present in 27 cases, droughts are present in 19, deforestation is present in 17, water scarcity is present in 15, floods are present in 9, storms are present in 7, and famines are present in 5. These forces are expected to intensify as climate change progresses, but Table 1 suggests they do not work in isolation. Underdevelopment, dependence on the environment for livelihood, high population density and growth, and income inequality are typically also present. Political push factors are less prevalent: a conflict push factor is present in 11 cases, public policy is present in 6 cases (promoting particular regions or offering incentives to migrants), and repression and persecution are present in 4 cases.

As shown, 19 of the 38 cases analyzed involved intrastate migrations, 6 cases involved interstate migrations, and 13 cases involved both. The highest number of migrants per episode occurred in Bangladesh (12–17 million), followed by the Sahel (10 million), Brazil (8 million), Philippines (4.3 million), Sudan (3.5–4 million), and Somalia (2.8 million), none of which, as expected, are DCs.

Conflict in the receiving area is present in 19 cases: 8 cases involved intrastate conflicts (Bangladesh-Chittagong Hill Tracts, Rwanda, Mexico, Haiti, Philippines, South Africa, Sudan, Pakistan), 3 cases involved interstate conflicts (El Salvador–Honduras, Ethiopia–Somalia, Mauritania–Senegal) and 8 cases involved inter-communal conflicts (Ethiopia – 1984/85,

[1] Additional sources are available upon request.

Table 1
Environmental migration episodes

Panel A: conflict

Origin, period	Destination	Environmental push factors	Other push factors	# Moving	Conflict in destination	Conflict intensity	Sources
1. Bangladesh, rural areas, coastal areas, islands, 1970s−1990s	Bangladesh, Chittagong Hill Tracts	Droughts, water scarcity, floods, storms, erosion, desertification	Overpopulation, underdevelopment, government migration incentives	600,000	Migrant−resident ethnic strife, insurgency	High	Hafiz and Islam (1993), Lee (2001), and Shelley (1992)
2. Ethiopia: (a) central/ northern; (b) Awash river basin-Afar, 1984−1985	Ethiopia: (a) southwest, west; (b) Wollo region	Drought, famine, forest fires, locust invasion	Underdevelopment, overpopulation, government promotes cotton/sugar, overgrazing	600,000	Nomad−farmer conflict over land	Medium	Ezra and Kiros (2001), Otunnu (1992), and Rahmato (1991)
3. Rwanda, rural south, center, early 1990s	Rwanda, north, Zaire	Arable land/water scarcity, land degradation, deforestation	Overpopulation, food scarcity, civil war, underdevelopment, government aid in north	1.7 Million	Ethnic tension with colonial roots, civil war, genocide	Very high	Kane (1995a, 1995b), Patterson (1995), and Uvin (1996)
4. Mexico, Southern Guatemala, 1960s−1990s	Mexico, eastern, Chiapas	Land degradation, deforestation, land pressure	Persecution, civil war in Guatemala, Mexican government resettlement policy, unequal land distribution, overpopulation	280,000	Peasants−loggers/ ranchers conflict over land, insurgency	High	Brown, Kane, and Roodman (1994), Collier (1994), and Renner (1996)
5. Bangladesh, various regions 1950s−current	India, West Bengal, Assam, Tripura	Droughts, water/land/ food scarcity, land erosion, storms, salt intrusion	India's diversion of Ganges River, failure to share river water, overpopulation	12−17 Million	Hindu−Muslim violence, massacre	High	Homer-Dixon (1999), Kalbag (1983), and Swain (1996)
6. El Salvador, 1950s−1980s	Honduras up to the late 1960s, then US	Deforestation, land degradation, arable land/water scarcity	Wealth disparity, skewed land-tenure, poverty, overpopulation, repression	300,000 to Honduras, 500,000 to US	Migrant−resident resource contest, border dispute, 1969 Soccer War	Very high	Durham (1979), Homer-Dixon (1999), and Myers (1993)

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Table 1 (*continued*)

Panel A: conflict

Origin, period	Destination	Environmental push factors	Other push factors	# Moving	Conflict in destination	Conflict intensity	Sources
7. Ethiopia/ Eritrea, 1960s–1980s	Southern Sudan	Droughts, famines	Underdevelopment, Eritrean secession, war	1.1 Million	Migrant–resident clash over water and land	Medium	Bilsborrow and DeLargy (1990), Jacobson and Wilkinson (1993), and Kane (1995a)
8. Mauritania, 1980s–1990s	Senegal, Senegal River Valley	Drought, soil erosion, desertification, deforestation, water scarcity	Moors–African enmity, interstate war, Senegal river dam raises land values and stakes, population growth	69,000	Border skirmishes, ethno-religious violence, riots	High	Baechler (1999), Black and Sessay (1998), and Westing (1994)
9. Somalia, late 1970s	Somalia–Ethiopia border region, Ogaden	Arable/grazing land degradation, water scarcity	Underdevelopment, population growth, interstate war	400,000	Migrant–resident water conflict, long-standing hostility	Medium	Gebramendhin (1991), Molvaer (1991), and Westing (1994)
10. Haiti, north, 1970s–1990s	Rural hillsides, l'Artibonite region, cities, Dominican Republic, US	Deforestation, land scarcity/degradation, erosion	Poverty, inequality, high density, repression	1.3 Million	Civil unrest, urban violence	Medium	Catanese (1999), Myers (1993), and Roper (1996)
11. Philippines, lowlands, 1970s–1990s	Philippines, center, uplands	Arable land/water scarcity, deforestation, floods, slides, drought, land degradation	Overpopulation, land/ wealth disparity, vague property rights, unemployment, underdevelopment	4.3 Million	Landowner–peasant tension, civil strife, insurgency	High	Cruz, Mayer, Repetto, and Woodward (1992), Myers (1993), and Saith (1997)
12. South Africa, black areas 1970s–1980s	South Africa, urban centers	Land degradation, deforestation, subsistence crisis, water scarcity	Repression, poverty, poor infrastructure, African unemployment, overpopulation	Up to 750,000 per year	Land squatters, social discord, violence	Medium	Baechler (1999), Lawson (1991), and Percival and Homer-Dixon (1998)
13. Sahel, rural areas, late 1960s–1980s	Sahel, urban regions, neighboring coastal states	Droughts, famines, land scarcity	Inflation, underdevelopment, overgrazing	10 Million	Unrest in drought areas, rejection of newcomers	Medium	El Hinnawi (1985), Jacobson (1989), Kane (1995b), and Russell, Jacobsen, and Stanely (1990)

14. Brazil, northeast, 1960s–present	Brazil, central and southern Amazon region	Droughts, land degradation, water scarcity, deforestation	Overpopulation, poverty, land disparity, government subsidizes settlers, vague property rights	8 Million	Clashes between landowners and squatters	Medium	Alston, Libecap, and Mueller (2001), Bilsborrow (2001), and UN (2001)
15. Sudan, north, south, west, 1970s–1980s	Sudan, Khartoum, Central, Kordofan, east	Droughts, famine, desertification, deforestation, erosion	Civil war, underdevelopment, policies against small farms and pastoralism, population growth	3.5–4 Million by early 1990	Government–migrant squatters clash, ethnic tension, nomads–landowners clash	High	Abu Sin (1995), Mahmoud (1998), and Unruh (1993)
16. US, Great Plains, 1930s	US, other regions	Droughts, sand storms, land degradation	Great Depression, over-plowing/grazing	2.5 Million	Rejection of migrants, contest over jobs, discord	Medium	Gregory (1989), PBS (2002), and Worster (1979)
17. Ethiopia, late 1970s	Ethiopia–Somalia border region, Ogaden	Grazing/arable land degradation, deforestation	Overpopulation, Ogaden War, land disparity, underdevelopment	450,000	Ethiopia–Somalia water and border dispute, resource competition, war	Very high	Gebramendhin (1991), Jacobson and Wilkinson (1993), and Molvaer (1991)
18. Nigeria, Jos Plateau, 1970s–1990s	Urban areas, intra-regional	Soil/water/air pollution, silted rivers, land scarcity/ degradation	Tin-mining, poverty, unemployment, high population density/ growth	n/a	Nomadic herdsmen–farmers conflict over resources	Medium	Ajaegbu (1994)
19. Pakistan, 1980s–1990s	Urban areas, especially Karachi and Islamabad	Water scarcity, deforestation, pollution, floods, land degradation	Population growth, unequal access to resources, poverty, unemployment, unclear land-tenure	n/a	ethnic discord, resource struggle, urban violence	Medium	Homer-Dixon and Percival (1996) and IOM (1996)

Panel B: no conflict

Origin, period	Destination	Environmental push factors	Other push factors	# Moving	Sources
20. Bangladesh, rural areas, 1970s–1990s	Bangladesh, urban centers	Droughts, storms, floods, water scarcity	Overpopulation, rural poverty	n/a	Baechler (1999) and Hafiz and Islam (1993)
21. China, primarily Gansu and Ningxia, 1980s–1990s	China, urban centers	Floods, land degradation, desertification, water scarcity	Mountainous terrain, poverty, malnutrition, government incentives	20–30 Million	Baechler (1999), Brown et al. (1994), and Smil (1995)

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Table 1 (*continued*)

Panel B: no conflict

Origin, period	Destination	Environmental push factors	Other push factors	# Moving	Sources
22. Ecuador, highlands, southern region, 1970s–1990s	Ecuador, northern Amazon	Droughts, deforestation, land degradation, water scarcity	Underdevelopment, constructing oil pipelines in Amazon region	n/a	Bilsborrow (2001), Pichon and Bilsborrow (1999), and UN (2001)
23. North Korea, 1995–2000	China, urban centers	Floods, tidal waves, droughts, land degradation, deforestation	Failure of collective farming policy, lack of infrastructure, poverty	300,000–400,000	Chu-Whan (1999), Lee (2001), and Yoon (1998)
24. Somalia, late 1980s–mid 1990s	Somalia-Ogaden, Kenya, Ethiopia, Djibouti	Drought, erosion, deforestation	Civil war in Somalia, population growth, overgrazing	2.8 Million	Cooper (2001), Kane (1995a, 1995b), and Kibreab (1994)
25. Guatemala, rural areas, 1950–1980s	Guatemala, north Peten region, urban centers, eastern lowlands, Pacific Coast, US	Land degradation, deforestation, floods, river sedimentation, water scarcity	Overpopulation, land inequality, underdevelopment, government promoting export crops, insurgency	100,000	Bilsborrow and DeLargy (1990), Sader, Reining, Sever, and Soza (1997), and UN (2001)
26. Dominican Republic, Las Ayumas, 1940s–1980s	Dominican Republic, Santiago's urban center	Deforestation, land degradation	Coffee price rise stimulates deforestation to grow coffee, poverty	Several tens of thousands	Bilsborrow (2001), UN (2001), and Zweifler, Gold, and Thomas (1994)
27. Canada, Great Plains, 1931–1939	Canada, other regions, urban areas	Droughts, sand storms, land degradation	Great Depression, over-plowing/grazing	300,000	IISD/EARG (1997), Lockeretz (1978), and Rosenzweig and Hillel (1993)
28. Mexico, rural areas, Oaxaca	Mexico, urban centers, US	Drought, land degradation, water scarcity, deforestation	Underdevelopment, inequality, population growth	600,000–900,000 annually	Arizpe (1981), Liverman (2001), NHI (1997), and Schwartz and Notini (1994)
29. Kenya, Western, Northern, 1960s–1990s	Kenya, Rift Valley, some remain in West, urban centers	Drought, land degradation, land scarcity, famine	Overpopulation, ethnic strife, inequality, unemployment	150,000–200,000	Dietz (1986), Gould (1994), and IOM (1996)

30. Uzbekistan, Kazakstan, Aral Sea, 1970s–2000	Within region or adjacent regions	Pollution, salinization, dust storms, water scarcity, sea desertification	Unemployment, underdevelopment, ethnic factor, water scarcity	65,000–100,000 Annually	Shestakov and Streletsky (1998), Small, van der Meer, and Upshur (2001), and UN (2001)
31. Caspian Sea region, Kalmykia, 1990s	Russia, neighboring regions	Inundation, floods, land scarcity	Ethnic pull factor, unemployment, underdevelopment	2200–8100 Annually	Chuykov (1995) and Shestakov and Streletsky (1998)
32. Russia, Kola Peninsula	Russia, various regions	Air pollution	Poor healthcare, social problems	5% of Population	Kane (1995b) and Specter (1994)
33. Burkina Faso, Mossi Plateau, 1960s–2000s	Burkina Faso, south, east	Drought	Underdevelopment, population pressures	n/a	Binama (1996), Cordell, Gregory, and Piche (1996), and Henry, Schoumaker, Beauchemin, and Dabire (2003)
34. India, west Rajasthan, East India, 1978–1983	India, Haryana, Madhya Pradesh, Madras	Drought	Underdevelopment	n/a	Jacobson (1989)
35. Zimbabwe, Southern lowlands, 1980s–	Zimbabwe, highlands	Drought	Unclear property rights, overgrazing, poverty, seasonal movement	n/a	Lonergan (1998) and Scoones (1992)
36. Thailand, northeast, 1980s–1990s	Thailand, other rural areas, urban centers	Deforestation, land scarcity/degradation	Underdevelopment	n/a	Bilsborrow (2001), Cropper, Griffiths, and Mani (1997), and Panayotou and Sungsuwan (1994)
37. Russia, Arctic region, 1990s	Russia, urban centers, other CIS countries	Extreme weather	Socioeconomic decline	70,000	Shestakov and Streletsky (1998)
38. Tanzania, Southern and northeast regions, 1950s–1990s	Usangu Plains, Tanzania	Land scarcity/ degradation	Overpopulation, poverty, government promotes commercial agriculture	84,000	Charnley (1997), Mwakipesile (1976), and Odgaard (1986)

Note: n/a denotes "not available".

Bangladesh–Assam/Tripura, Ethiopia–Sudan, Sahel, Brazil, US-Great Plains, Nigeria). Nine cases experienced high or very high intensity conflict, while the remaining 10 cases experienced medium intensity conflict.[2]

That said, 19 out of 38 episodes did not exhibit significant conflict. Fourteen of these cases involved intrastate migration, suggesting that conflict is less likely when migrants and residents are of the same ethnicity and religion, as is often the case for internal migration. It is also possible that the arrival of these migrants benefited the receiving areas, as discussed above, lessening the risk of conflict. In two cases, migrants moved to the US. While this sample is too small for generalization, it perhaps suggests that environmental migration to receiving areas in DCs faces a lower risk of conflict, which is also supported by the generally peaceful absorption of people displaced by Hurricane Katrina in the US.

These patterns support our theory. Environmental migration crosses international borders at times, and plays a role in conflict. Environmental migration does not always lead to conflict, but when it does, the conflict intensity can be very high, including interstate and intrastate wars. In almost all the conflict cases, the receiving areas were underdeveloped and depended on the environment for livelihood. Other factors associated with conflict include resident–migrant ethno-religious tension and competition over resources and resource scarcity in the receiving areas. Environmental problems *alone* do not explain the outcomes reported in Table 1, but they do appear to play important contributing roles in these episodes.

Policy implications

Scholars generally agree that in the absence of mitigation efforts, and assuming business as usual, the effects of climate change will be costly. The financial impact cannot be accurately predicted. Mitigation, however, is certain to be very costly. Facing this situation, one may take a ''wait and see'' approach, or act sooner, assuming that the costs of not acting will escalate. I consider this policy tension in light of my findings, assuming the goal is to minimize climate change-induced migration and conflict.

It is useful to start our policy discussion by looking at history. The drought in the US Great Plains in the 1930s was more severe than the droughts in the 1890s and 1910s, but the share of people leaving the region was smaller in the 1930s than in the 1890s and 1910s, because the federal government gave financial and technological assistance to farmers who stayed (PBS, 2002; Warrick, 1980). Responses to droughts in Canada were similar; the share of people leaving the affected areas in the 1980s was smaller than that in the 1930s because the government assisted those who stayed (IISD/EARG, 1997; Rosenzweig & Hillel, 1993).

Having found that public policy can mitigate environmental migration, how can we minimize migration due to climate change? Facing growing migration pressures of LDCs, the DCs have made immigration from LDCs more difficult.[3] I believe this approach will likely become less effective as climate change continues, facing ever-rising environmental migration pressures. Perhaps, as some scholars believe, human ingenuity will alleviate these pressures. Even if this is correct, innovation takes time. For example, the process of changing the global energy system is slow. In the meantime, the burning of fossil fuels continues, driving climate

[2] In this spirit, Salehyan and Gleditsch (2006) find that inflows of political refugees increase the risk of civil war in the host country.

[3] See, e.g., Andreas and Snyder (2001), BCIS (2003), IMR (2002), Martin and Widgren (2002), and Wood (2001).

change. Yet another possibility is that international institutional changes will solve the problem. These mechanisms have thus far failed.

My discussion suggests that LDCs will experience more climate change-induced migration and conflict than DCs. However, the political fallout may extend beyond LDCs. The inevitable feeling of hostility may foster a fertile atmosphere for global terrorism recruitment, which may already be underway. For example, British and Italian authorities have recently identified Eritrea, Ethiopia, and Somalia as fertile recruiting grounds for terrorists (Thibodeaux, 2005). This area has also experienced bouts of environmental migration in recent decades. Environmental migration may also create friction between major powers; for example, China may argue that the DCs' over-reliance on fossil fuels led to climate change-induced migration from its coastal zones due to a rising sea level.

Critics may argue that climate change is slow, providing ample adjustment time. However, climate change is expected to raise the frequency and intensity of extreme weather events, which play a role in migrations. Critics may also argue that economic growth in LDCs will solve the problem, financing mitigation and adaptation, and reducing dependence on the environment. However, this will considerably raise their demand for energy, and with the current technology, accelerate climate change.

Facing this conundrum, I propose that we take initiative early on, defending against climate change problems before they grow. This effort should focus on LDCs most vulnerable to environmental migration and conflict. For example, vulnerable LDCs could lessen their dependence on the environment for livelihood or protect certain areas against rising sea level. These programs will likely be lengthy, complex, and expensive; just the cost of defending the Japanese cities of Nagoya, Tokyo, and Osaka from a 1-m rise in sea level is estimated at $80 billion (IPCC, 2001).

Nevertheless, assuming we decide to implement this effort, who would fund it? The ''polluter pays'' principle which DCs implement at home, suggests that DCs should finance most of the effort required to defend the LDCs against the effects of climate change, as over-reliance of the DCs on fossil fuels is the primary cause of climate change. To be sure, my program will face problems of international collective action, and DCs will likely reject it if they consider it today. Whether they eventually accept it eventually depends on their attitudes toward risk. While exact figures are hard to pin down, my findings suggest that if we continue with business as usual, the expected cost of climate change-induced migration and the conflict it may cause in receiving areas will rise. This supports adoption of the proposed program sooner, rather than later.

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