BBVA | RESEARCH

Working Paper
Number 11/28

Migration and Climate Change: The Mexican Case

Economic Analysis
Mexico, August 2011

BBVA Bancomer

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Abstract

The June 2009 issue of Migration Watch Mexico by the BBVA Bancomer Foundation and BBVA Research mentioned the importance of environmental phenomena as factors of population expulsion or attraction. Expulsion occurs when in the communities of origin the environment begins to be detrimental to the life of human beings; for example, when there is environmental degradation and new risk zones appear, or when land is limited. In turn, the environment is a population attraction factor when the ecological quality of the environment is better compared to the zones of origin, thereby motivating migration.

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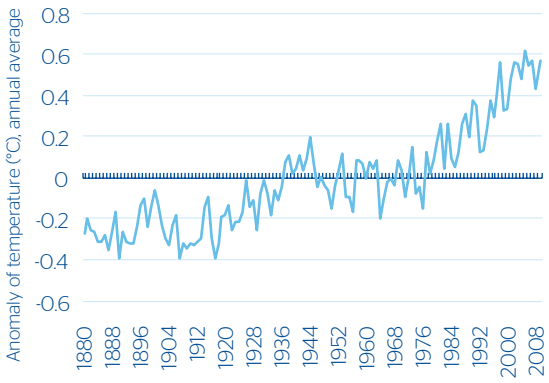
Evidence at the international level

Different studies at a world level have shown that the temperature of the planet has begun to rise in recent years. Of the twelve years of the 1995-2006 period, eleven are among the warmest in terms of the temperature records of the earth's surface since 1850. Also, the level of the world's oceans has been rising, due in part to rising temperatures and the meltdown of glaciers, icecaps and polar ice mantles. Since 1961 the increase in sea level has been an average of 1.8 mm/year, and since 1993 the rate has risen to 3.1mm/year, as indicated in the Fourth Evaluation Report of the Intergovernmental Panel on Climate Change (IPCC; 2007). This indicates that over the course of the twentieth century, the average temperature in the world had risen between 0.4° and 0.8° C, equivalent to an increase in sea levels of between approximately 1 mm and 2 mm on average each year (IPCC, 2002).

Among the factors that explain climate change are the changing concentrations of greenhouse gases and aerosols in the atmosphere, and variations in land cover and solar radiation. For more than 500,000 years, human beings have been liberating CO2 into the atmosphere through the burning of a variety of materials and changes in the use of the land. Over the last 200 years this activity has accelerated notably. Global emissions of greenhouse gases have increased as a result of human activities by 70% between 1970 and 2004 (Ramirez and others), while annual emissions of carbon dioxide (CO2) rose around 80% between 1970 and 2004 (IPCC, 2007).

Graph 1

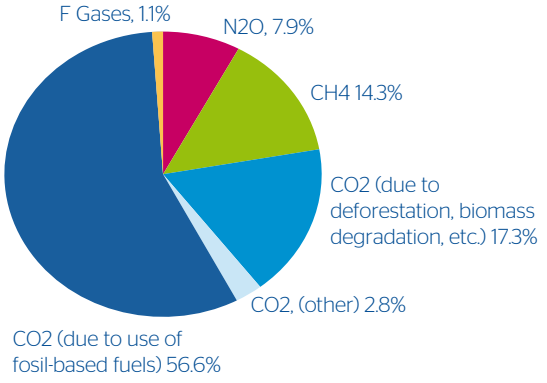
Land-ocean global temperature index 1880-2009



Note: The index is prepared by the Goddard Institute for Space Studies and combines the surface temperature of the ocean with the surface temperature of the air above the land
Source: NASA

Graph 2

Origin of greenhouse gas emissions (GGE) (Total CO2 equivalent emissions, 2004)



Source: Intergovernmental Panel on Climate Change (IPCC, 2007)

The increases in the global concentration of CO2 are due mainly to the use of fossil-based fuels, such as coal and, to a lesser though still significant extent, to changes in the use of the land. The atmospheric concentrations of CO2 and CH4 In 2005 were far higher than the natural variation of pre-industrial values. During the last 250 years, the human economy has dumped more than 1.1 billion tons of CO2 through the use of fossil-based fuels for the generation and use of energy, of which 770 million tons (70%) were over the last 50 years. As a result of deforestation, during the last 50 years alone more than 330 million tons have been emitted.

Chart 1

Projections of surface warming and the global rise in ocean levels at the end of the 21st century (Average global values)

	Temperature change (°C in 2090-2099 compared to 1980-1999)		Rise in ocean level in 2090-2099 compared to 1980-1999
Different scenarios	**Optimal estimate**	**Possible interval**	**Interval obtained based on models, excluding future rapid dynamic changes of ice flows.**
Constant concentrations in levels of the year 2000	0.6	0.3 - 0.9	Not available
Scenario B1	1.8	1.1 - 2.9	0.18 - 0.38
Scenario A1T	2.4	1.4 - 3.8	0.20 - 0.45
Scenario B2	2.4	1.4 - 3.8	0.20 - 0.43
Scenario A1B	2.8	1.7 - 4.4	0.21 - 0.48
Scenario A2	3.4	2.0 - 5.4	0.23 - 0.51
Scenario A1F	4	2.4 - 6.4	0.26 - 0.59

Notes: All the above scenarios are six testimonial IEEE scenarios. The approximate equivalent concentrations of carbon dioxide of radioactive forcing computed due to greenhouse gas emissions and anthropogenous aerosols in 2100 (see page 823 of the TIE) for illustrative testimonial scenarios B1, AIT, B2, A1B, A2 and A1F1 of the IEEE are 600, 700, 800, 850, 1250 and 1550 ppm, respectively
Source: IPCC (2007) Intergovernmental Panel on Climate Change

Some projections by the Intergovernmental Panel on Climate Change, composed of well-known experts on the subject from various countries, indicate that global greenhouse gas emissions will continue to increase over the coming decades and probably result in additional temperature increases. The Group's 2000 Report indicates that global greenhouse gas emissions could increase by 25% to 90% between 2000 and 2030. Thus, if the trends observed in recent years continue, it is highly probable that the temperature at the end of the century could be between 1° and 4° C higher, and in more extreme situations up to 6° C higher, than the levels observed during the period 1980-1999. Even in a conservative scenario, where the concentrations of greenhouse gas emissions remain constant, the temperature would increase on average by 0.6° C. Sea levels could rise additionally between 0.18 m and 0.6 m. In the most extreme case, more intense atmospheric episodes would occur; most of the ecosystems would be submitted to stress and during a process of change many species would be condemned to extinction and entire insular nations would be threatened by floods (World Bank 2009).

The Stern Report (2006) indicates that global warming will affect the basic elements required for the functional life of human beings, such as access to water, the production of food, health and the environment. If no actions are taken to reduce the current emissions and change the trends we have observed, the accumulated costs up to 2025 could be equivalent to losing between 5% and 20% of global GDP toward the middle of this century.

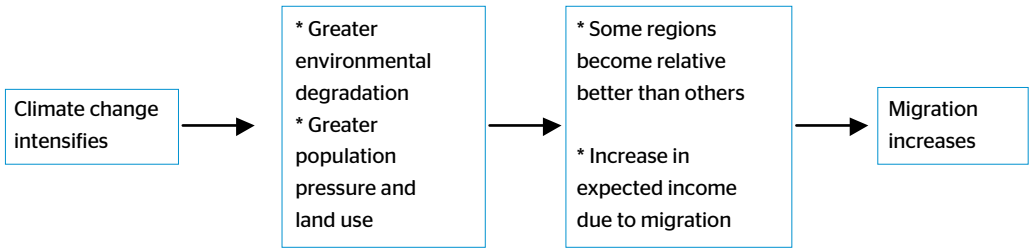
The environmental changes described above are creating great pressures that will contribute to migration and displacement of persons. In the next section, we highlight the possible links between migration and climate change.

The Link between Migration and Climate Change

Migratory movements due to environmental effects have been present for many years. However, it has only been in the last two decades that greater interest has been given to identifying and evaluating the link between the two variables. Warner and others (2009) note that climate is already a factor that contributes to migration. Although economic and political factors are the main contributors to migration[1] estimates show a broad range of impact from climate factors, suggesting that between 25 million and one billion persons could move as a result of climate change during the next 40 years (IOM, 2007).

Climate change has resulted in natural disasters, as well as greater environmental degradation in certain regions. As a result, many people have lost their homes and their means of production have deteriorated. Poverty could therefore increase and other zones less affected by climate change could become more attractive, thereby leading to migratory movements.

Chart 2
Channel through which climate Change could favor migration



Source: Economic Research Department, Mexico.

In view of the increasing importance that the link between migration and climate change, the International Organization for Migrations (IOM, 2007) has proposed a definition for those people who are forced to move due to the environmental consequences of climate change. "Environmental migrants" are those people, or groups of people, who due to a sudden or progressive change in the environment that adversely affects their lives are forced to leave their habitual homes, either temporarily or permanently, and to move either within their country or abroad.

Chart 3
Manner in which climate change could affect migration

- Intensification of natural disasters, such as hurricanes and cyclones that destroy housing and cause persons to relocate during short or long periods.
- Increase in temperature and droughts that affect agricultural production, reducing the population's means of subsistence and access to clean water.
- Rising ocean levels, making coastal areas uninhabitable.
- Competition for natural resources could lead to conflicts and in turn to displacements.

Source: Martin (2009)

[1] The first edition of Migration Watch Mexico included a review of economic literature on "The Determining Factors of Migration..."

According to Warner and others (2009), most people will seek refuge in their own countries, but others will cross borders in search of better opportunities. In other words, climate change would have greater effects on internal migration across the different regions in the countries. Some migrations and displacements could be prevented by introducing adaptation measures and an integrated management of water. However, many poor countries do not have sufficient infrastructure to adopt general adaptation measures, and migration would be a significant option, particularly in less developed countries.

Evidence of climate change in Mexico

The region comprised of Mexico and Central America is highly vulnerable to climate phenomena. There have been various natural disasters with considerable costs in this area; in 1998, hurricane Mitch hit Central America; in 2005, hurricane Stan affected Mexico and Guatemala; tropical storm Noel caused serious floods in Tabasco, Mexico. This has put the countries in the region among those heading up the Global Climate Risk Index. Harmelin (2009) ranks Honduras as the country in third place in this index for the 1990-2008 period, with Nicaragua in sixth place and Mexico ranking 30th.

Chart 4
Climate Risk Global Index: Mexico and Central America

Country	Position
Honduras	3
Nicaragua	6
Guatemala	24
Mexico	30
El Salvador	37
Costa Rica	61
Panamá	101

Sorce: Harmelin (2009)

Various climate scenarios have been considered for Mexico, many of them prepared by the Center for Atmospheric Sciences of the National Autonomous University of Mexico (UNAM) (see Centro de Ciencias de la Atmosfera de la UNAM, 2010). Most of them project that the average temperature by the end of this century could rise between 1° and 4° C, with the greatest warming in Northern and Northwestern Mexico. In the case of precipitation, although there are models that indicate that it could increase slightly, most predict reductions between 6% and 11% in the same period (Galindo, 2009).

Conde and Gay (1999) identify the Central and Northern parts of the country and the coastal region in Tabasco as the most vulnerable parts of Mexico. The areas in the north and those with large populations, particularly in central Mexico, are more vulnerable to drought and desertification, due to erosion and the increasing drought resulting from high temperatures and variations in precipitations in these arid and semi-arid regions. In turn, the coast of the state of Tabasco will be more vulnerable to changes in sea levels. Estimates suggest that the sea could penetrate between 40 and 50 kilometers.

Galindo (2009) finds that the economic consequences of climate change for Mexico vary widely between regions and there could even be temporary gains in some of these. However, in the long term, the negative economic effects surpass temporary gains. By 2100, the total economic costs of climate change, according to their calculations, would be equivalent to an accumulated loss of between 6% and 30% of Mexico's GDP, although the great uncertainty associated with these calculations has to be taken into account. One of the sectors in which major losses would occur is that of agriculture and livestock farming, so the rural population would be most affected.

Climate as a factor encouraging migration in Mexico

Numerous different aspects of migration have been analyzed in the case of Mexico, but the environment is an element that has only been touched on. A study by CONAZA (1994) more than a decade ago notes that 97% of Mexican soil has been affected to a varying degree by some process of degradation, and around 60% to a severe or extreme extent. As a result, migratory movements can reasonably be expected, mainly in the rural areas. Alain de Janvry and others (1997) argue that in the case of rural households in Mexico, environmental deforestation and the limited ownership of fertile land create an incentive to emigrate.

According to the figures of the Mexican Migration Project (MMP), most households in migrant communities do not possess land, and in most cases where they do own land, it is dry and not appropriate for agriculture. It is therefore possible to infer that the environment is playing an important role in encouraging the migration of Mexicans to the United States. The MMP sample corresponds to 124 bi-national communities of 19,906 households in Mexico and 922 in the U.S., who were interviewed at different times over the period from 1982 to 2009. The expansion factors of the survey were used when carrying out the exercise.

Chart 5

Mexico: households in migrant communities by type of land

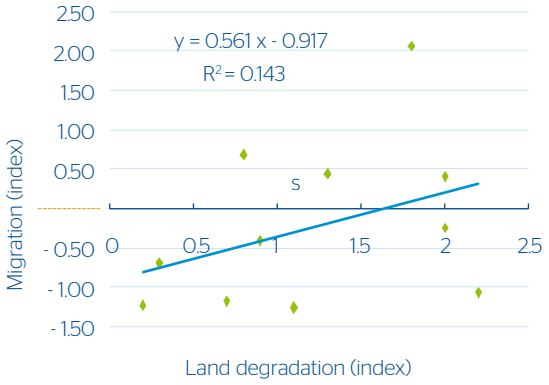
	Non-migrants	Migrants	Total
Irrigated	1,447	4,086	5,533
Moist	157	383	541
Dry soil	4,237	10,086	14,322
Pasture	305	640	944
Orchard	236	588	824
Other	22	120	142
Without land	42,667	96,803	139,470
Unknown	8	47	55
Total	49,080	112,752	161,832

Source: BBVA Bancomer with figures from database of the Mexican Migration Project (2010)

To find greater evidence of the relationship between the environment and migration, we compared the index of land degradation prepared by Cambell and Berry (2003) with the Conapo index of migratory intensity. Two groups were also defined from the poor states (with high or very high poverty levels) and the rest of the states. It was found that in the two groups of states there is a positive correlation between land degradation and migration, which is more accentuated when the states are poorer. This seems to suggest that when land is limited or not very fertile, and economic conditions are limited, as is the case in the poorer states, the incentive to emigrate tends to be greater (See charts).

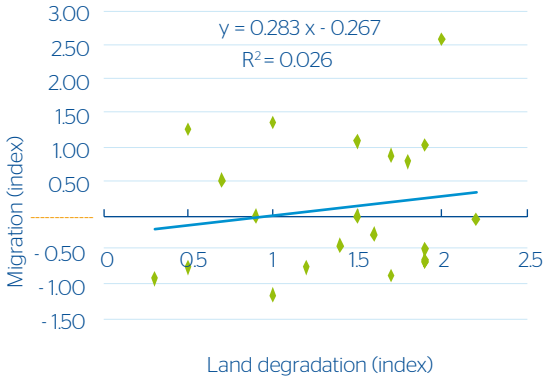
The case studies made for Mexico in the states of Tlaxcala and Chiapas as part of the project "Environmental Change and Forced Migrations Scenarios" (EACH-FOR) by Alscer and Faist (2009) concludes that there is a link between environmental degradation and migration in regions of Mexico. The erosion of the soil and the change in rain patterns has been an additional expulsion factor for emigration. In many cases emigration has served as a strategy of income diversification; remittances have been used, according to the study, mainly to cover basic needs and as substitute income in view of the decline in agricultural production, given its high dependence on climate.

Graph 3
Land degradation and migration in states with high or very high poverty levels



Note : The following states were considered : Campeche, Chiapas, Guerrero, Hidalgo, Michoacán, Oaxaca, Puebla, San Luis Potosí, Tabasco, Veracruz and Yucatán
Source: BBVA Bancomer, based on CONAPO estimates on a sample of ten per cent of the 12th General Population and Housing Census 2000

Graph 4
Land degradation and migration in states with medium, low or very low poverty levels



Note: The following states were considered: Aguascalients, Baja California, Baja California Sur, Coahuila, Colima, Chihuahua, Federal District, Durango, Guanajuato, Jalisco, Mexico state, Morelos, Nayarit, Nuevo Leon, Queretaro, Quintana Roo, Sinaloa, Sonora, Tamaulipas, Tlaxcala and Zacatecas.
Source: BBVA Bancomer, based on estimates by CONAPO from a ten percent sample of the 12th General Population and Housing Census 2000

Aguilar (1995) analyzes the future trends of human settlements and studies the effects of vulnerability to climate change. The results point in the same direction as those reported by Conde and Gay (1999). Five states in the country present high vulnerability: Chihuahua, Tamaulipas, Jalisco, the State of Mexico and Tabasco. Chihuahua could present high levels of increase in the total and urban population and in the consumption of water per inhabitant. The State of Mexico could also experience major population increases and a big rise in water consumption and supply. Jalisco would register a major population increase and also a rise in the incidence of infectious diseases. In Tabasco, the consumption of water per inhabitant would rise, as well as the incidence of infectious diseases.

Graph 5
Degree of vulnerability to climate change in Mexico: absolute differences, 1990-2025

Source: Aguilar (1995)

Chart 6
States in the Mexican Republic by degree of vulnerability to climate change

Degree of vulnerability	States
High	Chihuahua, Tamaulipas, Jalisco, Estado de Mexico y Tabasco
Medium	Baja California, Sinaloa, Coahuila, Nuevo Leon, Michoacan, Guanajuato, Guerrero, Puebla, Veracruz, Chiapas, y Quintana Roo
Low	Sonora, Nayarit, Aguascalientes, San Luis Potosi, Queretaro, Hidalgo, Distrito Federal, Morelos, Tlaxcala, Oaxaca, Campeche
Very low	Baja California Sur, Durango, Zacatecas, Colima, Yucatan

Source: Aguilar (1995)

Conclusions

Climate change is a confirmed fact. Projections indicate that if there is no radical change in current trends of accumulated greenhouse gas emissions, the temperature could rise by between 1° and 4° C by the end of the century, while sea levels would rise between 0.18 m and 0.6 m. This would lead to an increase of migratory movements around the world. Various studies reveal that climate is an element that is already affecting the displacement of people.

In Mexico, climate change is already showing signs of adverse effects. In the case of migration, although the subject has been studied only slightly, there is some evidence to indicate that climate change does indeed influence the displacement of people. The results found suggest that there is indeed a link between migration and environmental degradation. Most households in migrant communities do not own land, or it is not appropriate for agriculture. It is therefore reasonable to suggest that climate has been a factor that encourages some people to leave their communities and move either to larger urban zones within the country, or to emigrate abroad.

Some case studies reinforce the arguments expressed here. They show that soil erosion and changes in rain patterns have been an additional expulsion factor for emigration in some regions of Mexico, mainly in the rural areas.

The highest levels of vulnerability to climate change could be in states with rapid population growth, high water consumption levels and those that register a high incidence of infectious diseases. This situation could be present in the northern region (Tamaulipas and Chihuahua), in the central zone (Jalisco and the State of Mexico) and in the Gulf of Mexico (Tabasco), especially in rural communities.

States with medium level of vulnerability to climate change are Baja California, Sinaloa, Coahuila, Nuevo León, Michoacán, Guanajuato, Guerrero, Puebla, Veracruz, Chiapas and Quintana Roo.

The states with the lowest level of vulnerability are Baja California Sur, Durango, Zacatecas, Colima, and Yucatán, since the prevalence of infectious diseases, increases in water consumption per inhabitant and population growth tend to be lower compared with the rest of the states.

The results noted in this article show the need to consider climate change and its possible effects on the states when formulating migratory policies, in order to achieve an appropriate population distribution and reduce the vulnerability that climate change could cause on the inhabitants of Mexico as a whole. There is time, but good planning will help tackle this problem.

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