

Climate-Driven Migrations: How Climate Change will Reshape the Population Distribution in the World

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ABSTRACT

Firstly, the historical concept of migration is introduced, taking into account its drivers, mainly those related to environmental reasons. Then, the new displacements in recent years due to natural disasters are shown as demonstration that extreme weather events are leading to more climate-related migrations than in the past. Then, the research focuses on the future predictions which are presented as unstable by the uncertainties correlated to them: in particular, internal migrations within the countries in Sub-Saharan Africa, South Asia and Latin America are considered. The analysis continues with an overview on the interconnections between Climate Change, food insecurity and violent conflicts. The legal and policy responses to environmentally-driven migrations are then illustrated. In the end, two case studies are taken into account (Miami and Bangladesh) to evidence the problems, the future predictions and the management of the issue in countries with different GDP.

Introduction

Today, more people than ever live in a country different from the one in which they were born. As shown in Fig. 1, international migrants in 1960 were 77 million worldwide and they became 280 million in 2020. In percentage terms, they have increased from 2.6% to 3.6% of the global population. However, this huge displacement of people is nothing new. The history of humanity, indeed, is characterized by stories of migration in every era: it is possible to affirm, as Peter Scholten does in his *Introduction to Migration Studies*¹, that “as long as there are people, there has been human migration”. Homo sapiens started to migrate across the African continent 300,000 years ago, reaching the southern coast of Asia and Oceania 70,000-50,000 years ago and the European continent 40,000 years ago. Since then, humans have never stopped to migrate from their place of origin. Reasons that trigger migration are multiple and they are analysed by migration studies, which were recognised as a distinct research field only at the beginning of the twenty-first century¹. The decision to migrate, both as an individual behavioural option and a broader collective action, is highly context-dependent. However, these studies have identified some general driver dimensions and factors for migration. Among these dimensions, there is the environmental one, whose most important drivers are:

1. Climate Change
2. Environmental conditions
3. Natural disasters
4. Environmental shocks

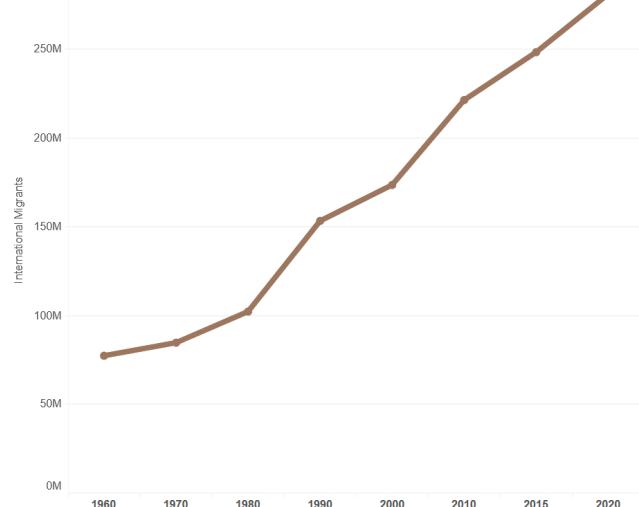


Figure 1. Migrant population increase worldwide 1960-2020²

These drivers have always influenced human migration. Even the 'Out of Africa' migration of Homo sapiens has been recently explained as triggered by changes in climate conditions, as shown in the Interactive Human Migration Map³ created by the California Academy of Sciences.

Climate migration, therefore, is not a new concept in the history of humanity. However, in recent years it has become a very urgent topic of debate at international level because of the dangerous and disastrous effects of Climate Change. The purpose of this analysis is precisely to investigate how Climate

Change is influencing and will influence human migrations all around the world. To do so, the current situation and the main predictions expected for the future will be studied. Moreover, the analysis will examine the correlations between Climate Change and other drivers of migration, and the efforts done internationally to cope with them. Finally, two countries with different GDP, but similar Climate Change-related problems, will be considered in order to understand how they are acting to mitigate them.

General Overview

Current Situation

The Norwegian Refugee Council monitors every year the number of displacements related to disasters and conflicts recorded worldwide. In 2020 the new displacements amounted to 40.5 million, the highest number in the last 10 years⁴. Among these displacements, 30.7 million were related to disasters and 9.8 million to conflicts and violence (Fig. 2).

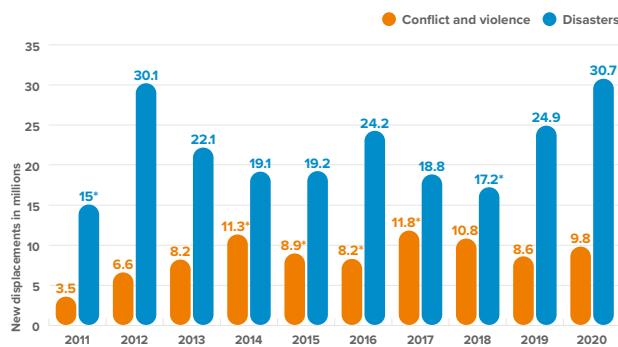


Figure 2. New displacements by conflict, violence and disasters worldwide (2011-2020)⁴

Specifically, weather-related events were responsible for 98% of all disasters displacements recorded in 2020⁴. Cyclones, hurricanes, typhoons, floods, wildfires, landslides, extreme temperatures, and droughts were the main causes of migration and they are becoming more and more intense due to Climate Change. Displacements were concentrated especially in the Bay of Bengal and in the Caribbean basin⁴. Indeed, all the world is affected by climate migrations, but the hardest hit regions are East Asia and Pacific, South Asia and the Americas⁴. On average, only in the Asian continent, almost 18 million people were displaced annually due to weather-related events from 2010 to 2020, mainly because of floods and storms⁵. In particular, environmental disasters trigger more frequently internal displacements than international migration⁶ as migrants typically move short distances after natural shocks.

Future Predictions

It is not easy to assess the future impact of Climate Change on migration because the predictions are affected by many uncertainties⁷, in particular for the following reasons:

1. Background situation: climate migration will take place in a background of high population growth and rapid urbanization⁷, in particular in those countries most susceptible to Climate Change.
2. Missing data: base reference scenario that takes into account the current migratory movements for Climate Change is missing⁷, meaning that the comparison with the future will be even more challenging.
3. Climate evolution: the evolution of the climate migration will be strongly affected by the evolution of the climate itself⁷ that will depend mostly on the path followed in the next years.

The future migrations will probably take place on the same directions historically taken, but also in forms of internal migrations within the country. Taking into account all the uncertainties related to these predictions, the World Bank expects that climate migrations will affect at least 216 million people around the world by 2050⁸ just in forms of internal displacements.

Internal Migrations

The future is uncertain but, in the meanwhile, studies can be looked at to be prepared for what may happen in the next decades. In particular, the World Bank's study *Groundswell*⁸ focuses on internal migration within Sub-Saharan Africa, South Asia and Latin America, which represent the most hit regions in the world when it comes to climate migration. Three different scenarios are proposed for these areas, according to the development path and to the level of GHG emissions.



Figure 3. Internal migration predictions in 2050⁸

- Pessimistic reference scenario: high GHG emissions and unequal development path are considered.

- More inclusive development scenario: high GHG emissions, but an improved development path are taken into account.
- More climate-friendly scenario: lower GHG emissions and an unequal development path are assumed.

The results of the study (Fig. 3) show that the internal climate migration will likely increase in 2050 in all scenarios, but it will be very significant if actions to contrast Climate Change are not put in place in the next years. It is in fact possible to observe that the major leading element to prevent climate migration is reducing the Climate Change drivers: just changing the development path without acting on the climate drivers is not sufficient to contrast the phenomenon. On the opposite, the number of climate migrants can be decreased by reducing some of the Climate Change drivers, as it is done in the climate-friendly Scenario for GHG emissions. In this case, Climate Change will force 50 million people to move within their country by 2050 in the three regions considered. This number is considerably lower than the 120 million predicted in the Business-As-Usual scenario and the 80 million expected by the More-Inclusive Development Scenario that just changes the development path but does not act on the climate drivers. Moreover, it is very clear that less people move if they have less reasons to do it.

Climate Migration, Food Insecurity and Violence

According to Morales-Muñoz et al.⁶, environmental change, food insecurity and violent conflict are some of the drivers of migration and they show complex interactions between them. Climate Change causes high temperatures and variable precipitations that may induce increased water scarcity and reduced yields of agricultural fields. Moreover, global warming may affect livestock production and fisheries, which are important sources of income and nutrients in the least developed countries. Environmental change will therefore affect the lives of rural communities in developing countries that depend mainly on agricultural production for their subsistence, leading to food insecurity. For example, in 2015 and 2016 droughts influenced by El Niño climate cycles caused food insecurity and famine in Eastern and Southern Africa, leading to human migrations in a certain number of countries⁶. According to a study by the World Food Programme in Guatemala, Honduras and El Salvador⁶, high rates of food insecurity represent a migration driver. However, migration reduces the availability of workforce and increases food insecurity. There is therefore a strict correlation between Climate Change and food insecurity that affects mainly rural populations, which are the most vulnerable to environmental changes and have a limited capacity to manage environmental risks. In these conditions, they often consider migration as an adaption strategy that helps them in diversifying their sources of income.

Environmental change is also strictly correlated to violent conflicts. Indeed, environmentally-driven migrations could trigger new conflicts in more vulnerable regions. However,

it is not possible to statistically test that climate-driven migrations trigger new violent conflicts because data on migration are not sufficient⁶. Many international agencies, instead, have assessed that conflicts are worsened by climate shocks like droughts. Moreover, food insecurity caused by Climate Change can lead to food price shocks, which can serve as a powerful trigger of social unrest. A study conducted on 113 African markets from 1997 to 2010, for example, detects positive feedback between food prices and violence, with higher food prices increasing conflict rates and conflict increasing food prices⁶.

The causal loop diagram in Fig. 4 summarizes all possible correlations between Climate Change, food insecurity, violent conflicts and migration.

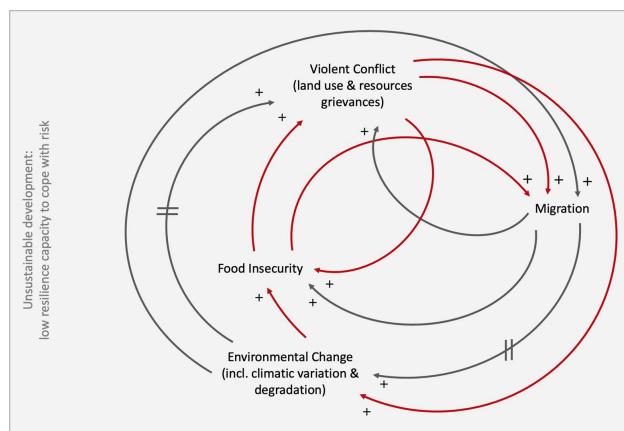


Figure 4. Correlations of environmental change, violent conflict, and food insecurity as drivers of migration⁶

Legal and Policy Responses

International Legal Framework

The internationally-recognized definition for refugee is the one given by the Refugee Convention, signed in 1951. According to it⁹, a refugee is a person who is outside of his or her country of nationality because of a well-founded fear of being persecuted for reasons of race, religion, nationality, political opinion or membership of a particular social group. As it is evident, it is difficult to apply this definition in the context of natural disasters triggered by Climate Change. Indeed, natural disasters do not persecute, while this is a fundamental feature of the refugee definition. However, regional refugee protection instruments employ a wider refugee definition¹⁰. For example, the Organization of African Unity Refugee Convention of 1969 extends the protection to people forced to leave their place for "events seriously disrupting public order"¹¹. This definition has been applied by some African countries, as Ethiopia and Kenya, to give assistance to victims of famine or natural disasters coming from neighbouring countries¹⁰. Similarly, the Cartagena Declaration on Refugees signed in 1984 by countries of Central America includes in the refugee definition people fleeing "other circumstances which have

seriously disturbed public order"¹². However, the application of the refugee definition to those displaced due to natural or environmental disasters is not necessarily required¹⁰. Moreover, these conventions apply only to cross-border migrants, while they are not related to internally displaced people (IDP), which already represent the majority of climate migrants. After a multi-year process, the Guiding Principles on Internal Displacement were created by UN. They define IDPs as people who were forced to leave their homes "as a result of or in order to avoid the effects of armed conflict, situations of generalised violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognised State border"¹³. Nevertheless, these guidelines are voluntary, meaning that they become binding only if states introduce them in their domestic laws. Moreover, if Guidelines Principles provide recommendations on facing environmentally-driven internal displacements, there is no global instrument concerning cross-border climate migrations. The international legal framework, therefore, does not protect people forced to leave their country due to Climate Change-related events and who are not protected by regional instruments.

Global Initiatives

In the last ten years, many global initiatives have tried to face the issue of climate migration. In 2012, for example, the Nansen Initiative was launched by Norway, Switzerland and other countries to help address the protection gap for people displaced across borders because of natural disasters and Climate Change¹⁰. The work of this initiative led to the Agenda for the Protection of Cross-Border Displaced Persons in the Context of Disasters and Climate Change, endorsed by 109 delegations in 2015¹⁰. This agenda aims at supporting states by recommending good practices to face Climate Change-driven displacements. Other initiatives include the Brazil Declaration and Plan of Action adopted in 2014 to address protection solutions for the next decades in Central and South America. Moreover, in 2017 Brazil promulgated a Migration Law that provides temporary visas for humanitarian reception for people displaced because of natural disasters¹⁰. Considering the African continent, instead, the Intergovernmental Authority on Development was created in the East Africa region to address droughts and desertification issues¹⁰. European Union, finally, recognizes the links between Climate Change and migrations, but hardly offers any concrete actions. This is mainly related to the almost nonexistence of cross-border migration triggered by Climate Change in the European continent¹⁰.

Case Studies

Climate migration is already a reality in some parts of the world and it affects both high-income and low-income countries.

In the following sections, two case studies are analysed.

1. Firstly, the city of Miami is taken into account, where

the Sea Level Rise (SLR) is threatening the future of the city.

2. Then, the analysis focuses on Bangladesh, one of the most vulnerable countries in the world when it comes to Climate Change. Both the current situation and the future development will be discussed.

Miami City

The sea level around Florida in the US is twenty centimetres higher than it was in 1950¹⁴, as it possible to observe from Fig. 5. The largest contributors to this phenomenon are the increasing rate in ice melting from the North and the South Poles, correlated to Climate Change, and the slowing of the Gulf Stream¹⁵. In coastal cities like Miami, this is causing major issues.

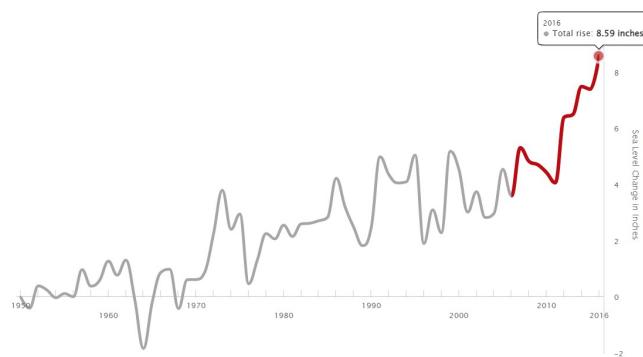


Figure 5. Sea level measurements from 1950¹⁵

Miami is not a coastal city like the others because it is more vulnerable to SLR: its foundations are built on porous limestone that acts like a sponge full of holes and it allows groundwater to rise at the same rate as the ocean, meaning that water can flow through the ground and bypass the sea walls that should protect the city¹⁵.

Future SLR forecasts for Miami are not reassuring: the level of the ocean is expected to continue to increase (Fig. 6), even faster than in the past¹⁵.

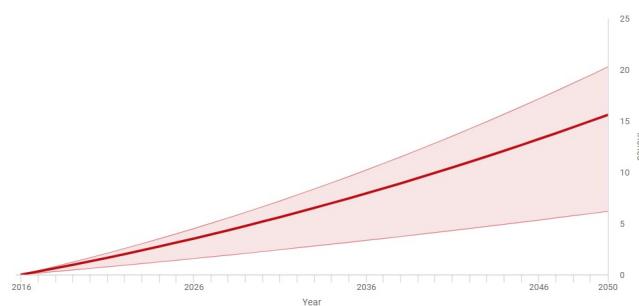


Figure 6. Sea level forecast in Miami Beach in 2050¹⁵

All these elements are contributing to the fast change that the city will be subject to in the next years as it is possible

to observe in Fig. 7, which shows how the city might look like in 2100. All the red zones are those that are expected to be below the 10-year flood level (i.e. the coastal flood level that has a 10% chance to occur in any given year): the city of Miami is projected to disappear, covered by the Atlantic Ocean.

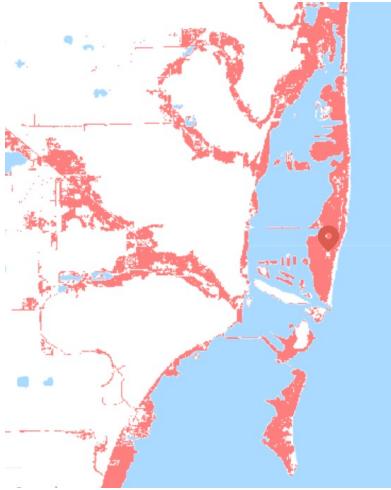


Figure 7. Zones below 10-year flood level in 2100¹⁶

The major drawbacks of this situation are listed below.

1. Flooding with no rain: the drainage system is designed to flow the rainwater from the streets to the sea but, due to SRL, seawater can enter the pipes and arrive in the streets¹⁵.
2. Hurricane-related flooding: even small SLR makes hurricanes more damaging because it allows hurricanes to push more water on the land¹⁵.
3. Saltwater into drinking water: the SLR may lead to important issues for the access to basic needs like clean water because the level of salinity in freshwater is increasing¹⁷.
4. Climate gentrification: there are several paths that could lead to this phenomenon, but it seems that floods are making houses in Miami much more expensive than in the past due to a superior investment pathway¹⁸. In fact, investments are being moved from high-risk locations, such as Miami Beach, to low-risk locations, such as Little Haiti¹⁸, which was historically a lower income neighborhood, creating social tensions among locals due to the increase of the living cost. Moreover, people that can not afford to move towards the inland are burdened by investments to make their homes climate resilient and by the need to stipulate an insurance policy against more frequent extreme weather events. It is particularly evident that Miami is fast becoming a city just for rich people, creating new inequalities and pushing people that lived there for generations to move.

The city of Miami says that it can adapt to Climate Change through some mitigation actions.

1. Reduce the drivers of climate migration: the objective is going carbon neutral and reaching net-zero GHG emissions by 2050¹⁹. The main proposals are related to reduce the number of private vehicles and switch them to electricity-based ones, to use carbon-free electricity and to improve energy efficiency of buildings.
2. Improve climate adaptation: the city allocated \$192 million for the Sea-Level Rise Mitigation and Flood Prevention plan in the Miami bond¹⁹. As previously explained, due to the specific characteristics of the ground, traditional engineering solutions, such as sea barrier, do not work. For these reasons, possible solutions to contrast flooding are mainly related to raise the roads and buildings level. In order to reduce the flooding due to seawater in the drainage system, one-way valves and pumps have also been installed²⁰: they allow the pumping of the water from the streets to the sea to get it out, but they do not allow the passage of water in the opposite direction.
3. Equip affordable housing: inequalities between citizens due to climate resilience of the buildings are tried to be kept low also through the Keep Safe Miami program¹⁹, which provides strategies and guidance to the owners for financing and addressing climate vulnerabilities. Moreover, recently a competition has been held by the platform *Arch Out Loud*²¹ for ideas to exploit the potential of floating housing in order to create affordable and climate resilient homes.

Actually, the city of Miami is not alone: the phenomenon will affect almost all the locations near the oceans and it will have consequences in all the territories of the US.

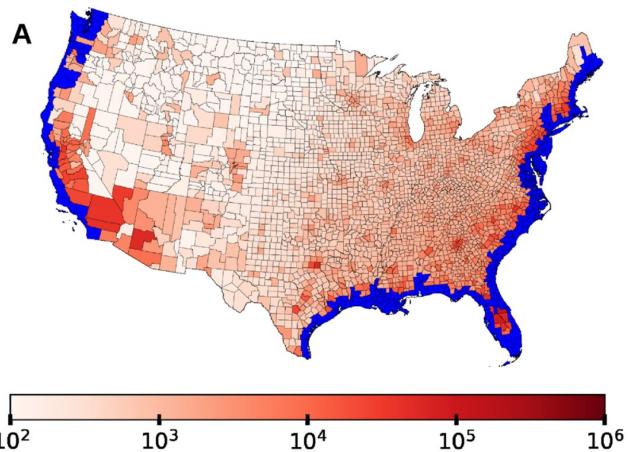


Figure 8. Climate migration predictions in US under 1.8 m of SLR²²

In Fig. 8, the counties in blue are those that will experience flooding under 1.8 m of SLR by 2100, while the red

counties will host additional incoming migrants, with different intensity of the colour depending on the number. The results²² highlight that approximately 56% of the counties will be affected directly or indirectly due to climate migration within the US: people from the coastal cities will be forced to move towards the inland, but the inland areas will be affected too due to the larger migrant influxes that will cause social imbalances.

Bangladesh

Bangladesh is a particularly vulnerable country to Climate Change. Indeed, the Global Climate Risk Index²³ rates it as the seventh most affected country in the world from extreme weather events over the last two decades.

The vulnerability of the country to environmental disasters is strictly connected to its geography and natural characteristics. Two large rivers originating in the Himalayas flow across the country from North to South, the Ganges and the Brahmaputra. The second one merges into the Ganges, which then flows into the Bay of Bengal. During the monsoon season, their water volume increases so much that it causes numerous floods in the country, exposing its 166 million inhabitants to dangerous risks. Another important river in Bangladesh is the Pashur river. It flows across the Sundarbans region, which is home to the world's largest mangrove forest. The sea level increase correlated to Climate Change makes saltwater entering the channels of the river, impacting enormously on the ecosystem of the forest. In addition to floods and cyclones, the country is affected by droughts, mainly in the West North as shown by Fig. 9.

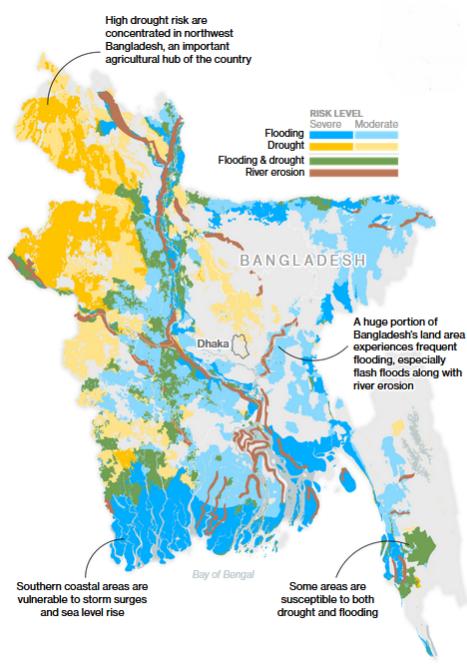


Figure 9. Environmental risks faced by Bangladesh in different regions²⁴

Extreme weather events and sea level rise correlated to Climate Change are therefore flooding Bangladesh and destroying its fragile ecosystem, although Bangladesh's current contribution to global greenhouse gas emissions is just 0.4%²⁵.

People living in the coastal areas, almost 35 million, are the most affected by sea level rising and flooding. Many of them decide to leave and in the 42% of cases they move to the capital, Dhaka, which hosts 2000 people a day, 4000 during the monsoon season²⁶. Today the capital has a population of 20 million people, but one third of them live in slums. It does not have the adequate infrastructure to host all the climate migrants coming from the coastal regions, and, as a result, climate refugees mainly live in illegal squatter settlements, from which they are regularly evicted by local officers²⁷. Climate migration is therefore strictly correlated to poverty, as many climate refugees live in poor and difficult conditions. This correlation is so important that the World Bank²⁵ showed the correlation between extreme weather events and poverty in the different areas of Bangladesh (Fig. 10).

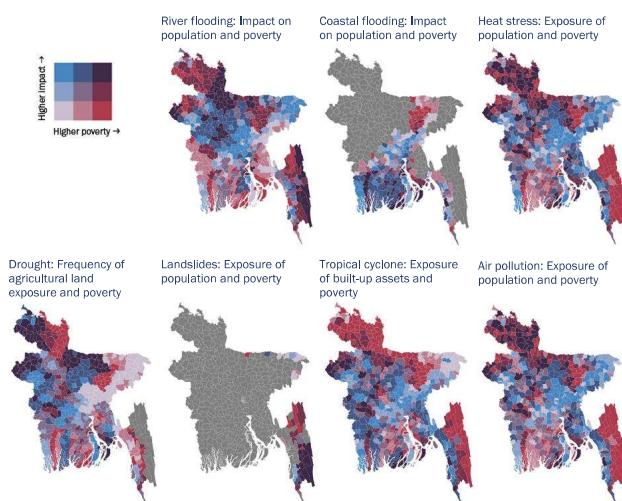


Figure 10. Correlations between poverty and Climate Change impact²⁵

The situation will even worsen in the future. A one-meter rise in sea level would submerge almost 20% of the country and displace more than 30 million people²⁸. This huge number of migrants represents a threat for the capital, which will probably be the preferred destination for displaced people. Indeed, Dhaka is located on an alluvial flatland and is surrounded by lakes and rivers, so it could be badly affected by Climate Change as the rest of the country.

In 2009 the Bangladesh government published the Bangladesh Climate Change Strategy and Action Plan to organize the actions needed to meet the challenges of Climate Change²⁹. It is composed of six areas of intervention:

1. Food security, social protection and health
2. Comprehensive disaster management

3. Infrastructure
4. Research and knowledge management
5. Mitigation and low carbon development
6. Capacity building and institutional strengthening

This plan aimed at scaling up the \$10 billion-investments made in the previous 35 years to make the country less vulnerable to natural disasters. It proposed a ten year program to strengthen the resilience of Bangladesh against Climate Change and it had been followed by the creation of a National Climate Change Fund to finance actions aimed at achieving this objective. However, after 10 years the Bangladeshi government did not publish an updated plan to organize its future actions. In 2022 the World Bank suggested to the local government further investments in infrastructures and services to strengthen the climate resilience and avoid the worst effects related to Climate Change-driven migration in the country³⁰. The three priority areas for Bangladesh's climate-resilient growth and development are:

1. People-centric and climate-smart development: the development approach followed by the country should consider regional variations in climate impacts. Investments in public services, nature-based solutions and infrastructure in urban areas will help cities prepare for an influx of climate migrants in next years. Nature-based solutions will be particularly important, as they represent one of the cheapest way to adapt to Climate Change. Some of these solutions, as restoration of mangroves and conservation agriculture, have already been realized, but they need to be widened in the future³¹.
2. Delivering development benefits with decarbonization: emissions reduction can have advantages in terms of air pollution, health costs and jobs.
3. Enabling environment and institutional realignment: thanks to a stronger legislative and institutional capacity, Bangladesh can accelerate the implementation of already existing policies and programs. It will be important also to empower local governments to plan and implement adaptation measures.

Conclusions

Migration is not a new concept for humanity, as it has always existed since the beginning of the human development on Earth. Humans have often migrated for reasons correlated to climate conditions, but in recent years climate migrations have become an urgent topic of debate due to dangerous risks associated with Climate Change. In particular, the most vulnerable regions are Sub-Saharan Africa, South Asia and Latin America, which are also the poorest areas in the world. Moreover, Climate Change especially affects rural communities, whose subsistence is based on agricultural production, causing

food insecurity and triggering migrations. Food insecurity and environmental change are also strictly correlated to violent conflicts, which are more likely to arise in unstable conditions. Future predictions on climate migrations are difficult to assess, but even in the most optimistic scenario many people will be displaced by 2050, mainly within the borders of their country of origin. For these reasons, it is important that the international community implements actions that mitigate the effects that climate migrations will have, especially in the most fragile and unstable regions. Nowadays, the international legal framework does not sufficiently support people fleeing their country for Climate Change-correlated reasons. Moreover, initiatives implemented in the last years have been more focused on internal displacements rather than on cross-border ones. In the case of Bangladesh, for example, the World Bank has only given suggestions to the country to implement policies aimed at facing internal climate migrations problems, but has not involved neighbouring countries in the discussion, even though they might be affected by migrations from Bangladesh. Another problem that has been highlighted is the insufficient availability of data concerning migration, which has prevented researchers from investigating the interconnections between the many drivers of migration. It is therefore necessary to collect more data on migrations, so that deeper analysis can be carried out on the correlations between migration drivers. In conclusion, as climate migrations are associated with many SDGs identified by United Nations (1, 2, 10, 11, 13, 16, 17), internationally-led efforts are fundamental to face problems correlated to climate migrations in order to reach a sustainable and equal future for all.

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