Disaster displacement risk in Bangladesh

An overview of the risk of future displacement by riverine floods, storm surges, cyclonic winds and droughts at the national and sub-national levels

iDMC internal displacement monitoring centre

Acknowledgements

Lead authors:

Sylvain Ponserre

Vicente Anzellini

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Cover photo: Storm-damaged homes in a small fishing community in southern Bangladesh. More frequent and intense storms are destroying homes and forcing families to flee. © NRC/Ingrid Prestetun

Three women wade through a flooded river in Bangladesh. The United Nations World Food Programme and the United Nations Central Emergency Response Fund use forecasts to help people prepare for the next climate-related shock in Bangladesh. © Sayed Asif Mahmud/WFP

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Flooding in Chattogram Division, Bangladesh. Storms and floods trigger most of the country's disaster displacements each year. © IFRC/ Shimul

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Introduction

Every year, floods, droughts, storms, earthquakes and other natural hazards force millions of people to leave their homes. Latest data from the Internal Displacement Monitoring Centre (IDMC) shows that 45.8 million of internal displacements, or movements, associated with disasters were reported in 2024, the highest figure on record and far above the decadal average of 26.5 million.

Fleeing can be the first of many further disruptions to people's lives, however. Not only their livelihoods are affected, but it can take weeks or even months before they are able to return. Those who do return often face unsafe conditions and the prospect of being displaced again by the next disaster.

While understanding historical trends is key, looking at the past is not enough. Producing information and analysis on the risk of future disaster displacement can help reducing risk and build resilience before hazards strike, thereby minimising the impacts of disasters, including displacement. In 2017, IDMC began a unique probabilistic modelling exercise for disaster displacement, assessing the likelihood of population movements in the future at a global level. The model used a state-of-the-art probabilistic approach, like that applied by catastrophe modelers and the insurance industry over the past few decades. It built on a risk analysis developed by the UN Office for Disaster Risk Reduction (UNDRR), which considered a wide range of hazard scenarios, their likelihood, and their potential to cause housing damage, which was used as a proxy to assess the likelihood of people getting displaced.

The model provided disaster displacement risk data at the national level (Admin 0), and defined vulnerability from a purely physical perspective -e.g structural vulnerability of buildings being severely damaged or destroyed by different hazard intensities-, without taking into account other socioeconomic factors including poverty, inequality and access to services, nor how global warming could affect the frequency and intensity of certain weather-related hazards.

Understanding physical impacts alone is not sufficient to fully capture displacement risk, however. Given that people's level of vulnerability and exposure to hazards does much to determine the severity of a hazard, it is important to assess how these aspects may change over space and time, and to unpack the economic, social and environmental factors that affect disaster risk, including optimistic and pessimistic climate change scenarios.

To refine further the granularity and comprehensiveness of its model, IDMC collaborated with several partners to develop an updated version that incorporates the latest hazard scenarios, both optimistic and pessimistic climate change projections affecting their frequency and intensity, new exposure layers, and an enhanced vulnerability component that goes beyond structural building fragility. The model assesses the risk of severe housing damage or destruction, as well as the loss of livelihoods for certain hazards, to estimate the probability of displacement. In essence, it focuses on the risk of medium- to long-term displacement and does not account for or model pre-emptive evacuations. Compared to the previous model, data is provided at Admin 1.

While still work in progress, the first results at a global level were obtained in early 2025, allowing to have a more detailed picture of global disaster displacement risk. As part of a series of papers on disaster displacement risk at a national level, the objective of this report is to advance our collective understanding of the current interlinkages between disasters, displacement and climate change, and better anticipate their future evolution. Given that "riskscapes" are constantly evolving, we need to better understand population and socioeconomic patterns, as well as fluctuations in the frequency and intensity of climate-related hazards in order to act more efficiently and ensure that no one is left behind.

Children in coastal fishing town in southern Bangladesh. Intensifying storms repeatedly damage homes and leave communities at growing risk of internal displacement. © NRC/Ingrid Prestetun

Disaster displacement in Bangladesh: historical trends (2008-2024)

Bangladesh is located on the Bay of Bengal in South Asia. The country lies in a low-lying delta formed by a dense network of major river systems and their tributaries including the Brahmaputra-Jamuna, Ganges-Padma, Surma-Meghna, and the rivers of the Chittagong region.[1]

The country covers a total land area of more than 147,000 square kilometres and its topography is predominantly low and flat.[2] Most of the territory lies below 10 metres above sea level, with elevations decreasing toward the southern coast. Due to its low-lying terrain and dense river network, flooding and storm surges are common, often displacing people through consecutive disasters and making it highly vulnerable to the impacts of climate change.

With a population of 171 million, Bangladesh is the eighth-most populous country in the world and one of the most densely populated.[3] Among its divisions, Dhaka has the highest population density, with approximately 2,100 people per square kilometre. The Dhaka District alone hosts roughly one-quarter of the country's total population. [4]

The riverine and coastal environment is inherently dynamic, and communities have traditionally adapted to these shifting landscapes. However, climate change has intensified existing pressures and introduced new challenges. In addition to more frequent and severe tropical cyclones, floods, and droughts, sea levels are rising faster than the global average, threatening people's health, lives, and livelihoods.[5]

In 2024, the number of disaster displacements rose for the fourth year in a row in the country to reach 2.4 million, its third highest figure on record, superseded only by the 2019 monsoon floods and the combined impacts of floods and cyclone Amphan in 2020. A wetter monsoon and the impacts of major storms explain the rising trend.

Disasters have triggered around 21.2 million displacements in Bangladesh since IDMC began systematically monitoring data on the phenomenon in 2008 (see Figure 2). Since, Bangladesh has been impacted by 11 cyclones. The data shows that the number of movements detected over the years has fluctuated, depending on the severity and frequency of hazards the country faced. When multiple cyclones occur consecutively, or when severe monsoon rains and floods coincide with cyclones, displacement numbers can reach millions.

IDMC has recorded 123 disaster events that triggered displacement, the overwhelming majority of which have been triggered by weather-related hazards, notably cyclones and floods (see Figure 1).

The Government of Bangladesh has made significant investments in cyclone preparedness, community-based early warning systems, delta management, and structural interventions to protect development gains, and many of the movements have been pre-emptive evacuations, the result of improved early warnings that allow people to move out of harm's way ahead of major cyclones making landfall. About 11.3 million displacements triggered by cyclones across the country took the form of pre-emptive evacuations, testimony to government-led efforts to save lives and prevent injuries. Many such movements only last for a short period of time, but every year disasters still leave tens of thousands of people without a home to return to rapidly.

In 2020, cyclone Amphan triggered the highest number of internal displacements recorded in Bangladesh since 2008, at around 2.5 million, mostly pre-emptive evacuations. Many evacuees were able to return relatively quickly, but housing destruction data suggested that more than 55,000 homes were destroyed, leaving about 10 per cent of the evacuees homeless, therefore prolonging their displacement.[6]

In 2023, Cyclone Mocha was the largest disaster event to trigger displacement in South Asia. The storm formed in the Bay of Bengal on 11 May and triggered 1.3 million displacements in the country, mostly in Chattogram division's Cox's Bazar district. Again, almost all the movements were pre-emptive evacuations from densely populated areas. Forecasting and early warnings helped authorities to put emergency procedures in place a week before Mocha's landfall. However, St Martin's Island was evacuated to avert deaths, and boats were pulled ashore to protect tourism and fishing livelihoods. The cyclone destroyed around 1,200 houses, leaving about 4,900 people, almost half of the island's population, facing prolonged displacement.

In terms of floods, Bangladesh has a humid, warm climate influenced by pre-monsoon, monsoon and post-monsoon circulations and frequently experiences heavy precipitation.[7] In 2020, the monsoon in was the longest since 1988 in the country and caused the worst flooding in a decade. Satellite imagery showed that about a quarter of the country was already underwater at the beginning of June. Around 5.4 million people were thought to have been affected by the time the floods reached their peak in early August. The monsoon triggered around 1.9 million displacements nationwide that year. Some people sought refuge in government shelters, but others did so on high ground, roadsides and embankments.[8]

Few years later, the monsoon floods in 2024 triggered about 1.3 million movements, particularly in Sylhet division where 723,000 took place in June alone. Factors such as unplanned urban expansion, impermeable land cover and blocked drainage canals increased the severity of the floods. They were also aggravated by cyclone Remal, which overwhelmed the capacity of several river basins to discharge water when the monsoon rains arrived.[9]

Figure 1: Internal displacements by disasters in Banglasdesh, 2008-2024

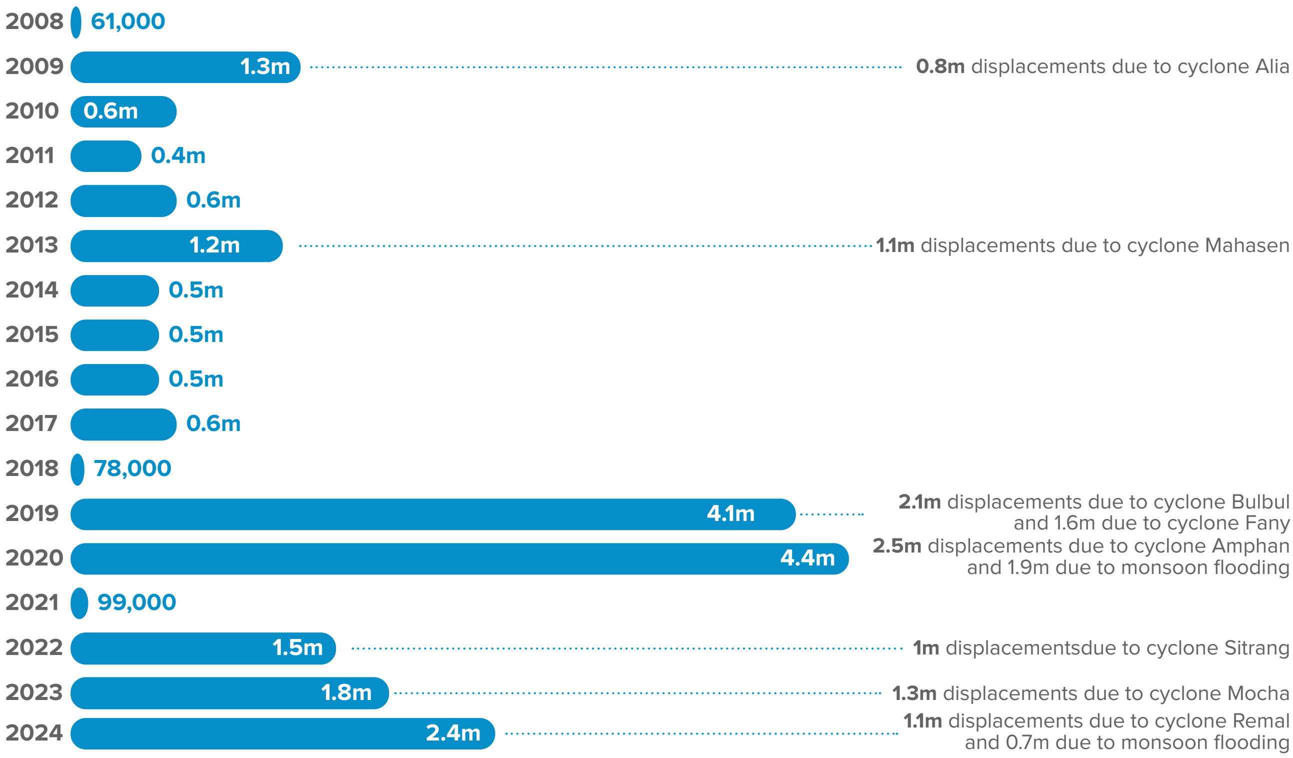
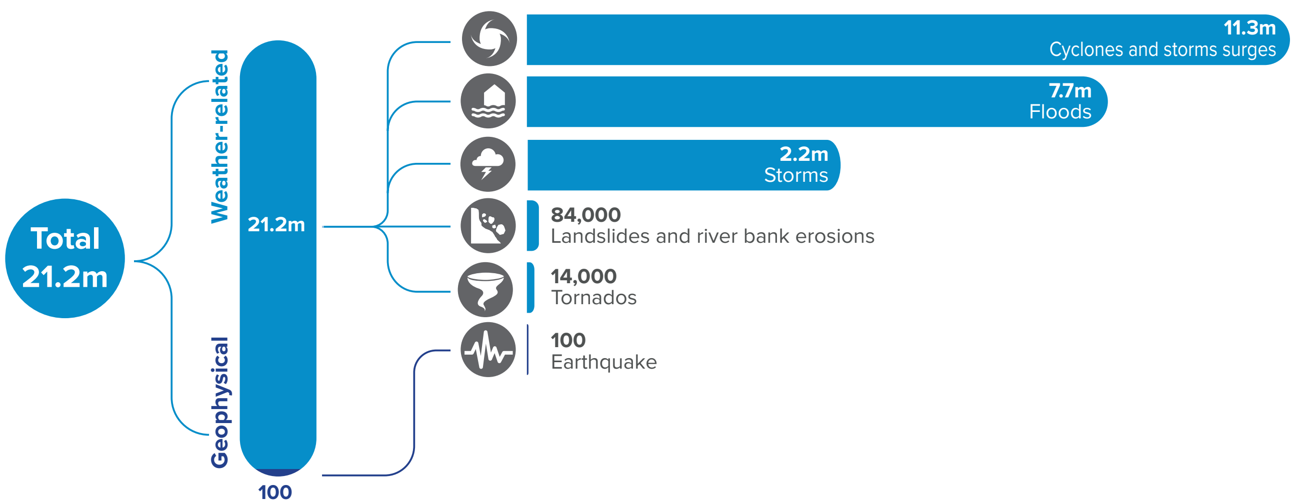


Figure 2: Breakdown by hazard in Banglasdesh



Displacement risk concepts

The need for a broader approach, using probabilistic risk assessment

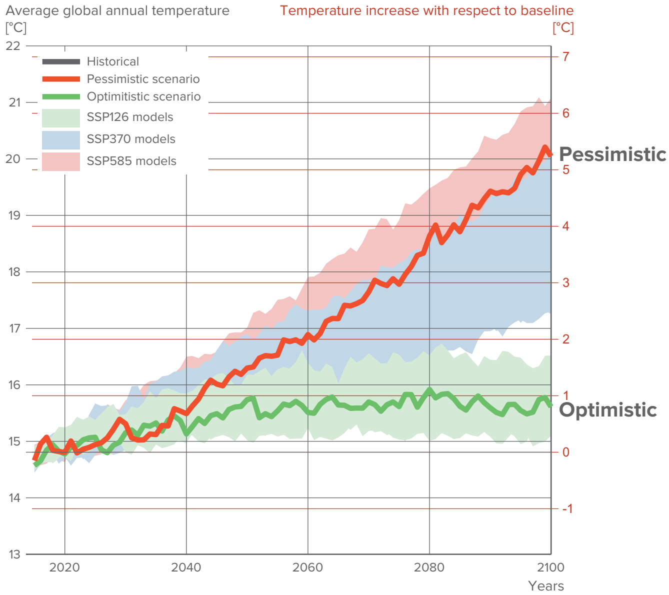
Before diving into the results of the displacement risk model, it is important to first understand key concepts underpinning the modeling approach and how it integrates diverse climate scenarios. These elements are essential to better interpret the outputs.

The baseline established by our new global disaster displacement risk model presents results at the national level downscaled at admin 1 resolution, and provides insight into future displacement situations in a changing climate in Bangladesh.

It uses a probabilistic approach, applying statistical methods to estimate the likelihood and potential impact of different hazard scenarios. It accounts for uncertainty by analyzing a range of possible outcomes rather than a single deterministic prediction, and evaluates the risk of severe housing damage or destruction, along with livelihood loss for certain hazards, to estimate the likelihood of displacement. It primarily focuses on the risk of medium, to long-term displacement and does not include or model pre-emptive evacuations which means its estimates are inherently conservative.

The outputs are presented using two key metrics: Average Annual Displacement (AAD) and Probable Maximum Displacement (PMD), disaggregated by hazard type and downscaled to the administrative level 1 resolution.

Figure 3: Illustration of different climate scenarios



The new generation of the Global Displacement Risk Model integrates the potential impact of climate change on the future frequency and intensity of extreme events (see Methodology). To facilitate interpretation of the outputs, we have consolidated the results under three different scenarios:

- Under the **current** climate condition
- "**Optimistic**", corresponding approximately to an average temperature rise of about +1°C by 2100
- "**Pessimistic**", corresponding approximately to an average temperature rise of over +5°C by 2100

Displacement risk metrics

To represent how many people are at risk of displacement in a given country, the commonly used and comparable metric is **Average Annual Displacement (AAD)**, which measures the expected magnitude of future displacement by hazard type that a country is likely to experience. It does not indicate the actual number of displacements that will occur each year, but rather the average annual number projected over a long time period, taking into account all potential events. (See methodology section for more details.)

AAD represents the annualized, accumulated effect of all events in the hazard catalogue. It is a compact metric that captures the expected displacement from both medium and extreme events. The model estimates that under the current climate conditions, 740,000 people could be displaced by riverine floods in Bangladesh in any given year in the future, on average.

While AAD is useful for conveying the scale of displacement risk on an annual basis, it tends to mask potential outliers. High-intensity but low-frequency events, such as a Category 5 cyclone or a magnitude 7 earthquake, could cause mass displacement, even if they occur only rarely.

To better account for such extremes, we also use a second metric: **Probable Maximum Displacement (PMD)**. PMD represents the maximum number of displacements expected within a given return period, capturing the outlier scenarios mentioned above. It is especially useful for preparedness planning, such as determining the size and scope of shelters, infrastructure, and emergency response assets a government may need.

The likelihood or probability of displacement is usually expressed in terms of a return period, which is often misunderstood. A return period is the average time interval in years that separates two consecutive events equal to or exceeding the given magnitude. The most common misconception is that an event with a 100-year return period will only occur once a century. In fact, it means that it has an exceedance probability of 1/100, so events of the same or greater intensity happen once every 100 years on average. It does not preclude more than one event with a 100-year return period happening within a century or even the very small probability of back-to-back events one year after another. Nor does it rule out a century passing without such an event occurring.

AAD

Average Annual Displacement (AAD) is a measure of the magnitude of future displacement by hazard type that a country is likely to experience. It does not reflect the number of displacements it will face each year, but the number it can expect per year considering all the events that could occur over a long timeframe. AAD is a compact metric with low sensitivity to uncertainty.

PMD

Probable Maximum Displacement (PMD) is the maximum displacement expected within a given time period. It answers the question: What is the maximum expected displacement within a range of X years? It represents the outlier event that could occur during a specific time frame. PMD can be used to determine the size of shelters and other assets that a government needs to provide to cope with the potential magnitude of displacement.

Disaster displacement risk in Bangladesh: results by hazard type

Looking only to the past is not a reliable guide for understanding what may occur in the future or how best to prepare for it. As climate patterns shift and hazards evolve, it becomes increasingly important to use forward-looking tools, such as predictive modelling to anticipate future displacement risks and inform proactive planning and preparedness efforts.

Riverine floods

The analysis of flood displacement risk at a country level shows an Annual Average Displacement (AAD) value of around 740,000 people. When looking at the results under optimistic and the pessimistic climate change scenarios, the model points at an increase in AAD values, which may double in the worst-case scenario.

When downscaling the analysis to the district level, several notable trends emerge regarding how risk evolves under the two scenarios (see Figure 4). In most districts, the risk of displacement due to riverine flooding is projected to increase under the pessimistic scenario. In Khulna, this risk could multiply almost 10 times over, assuming the current population distribution remains unchanged under the worst case.

In Sylhet, under the current climate condition, Annual Average Displacement (AAD) risk is the highest, affecting nearly 183,000 people. This risk could increase by 50% under the pessimistic climate scenario. However, under the optimistic scenario, it could decrease slightly compared to the current level.

Dhaka, the capital of Bangladesh and home to over thirteen million people, and still growing, is traversed by six rivers that have been vital to trade, transport, and livelihoods for centuries. The district ranks as the second most at risk of displacement in Bangladesh, with the Annual Average Displacement (AAD) projected to be 181,000 people.

While the Annual Average Displacement (AAD) reflects the average number of flood-induced displacements over a long time frame, it tends to mask potential outliers. Understanding the impacts of these outliers, and estimating the number of people potentially displaced during frequent (low return period) or rare (high return period) events, is essential. It is evident that the number of people at risk of displacement increases significantly with higher return periods.

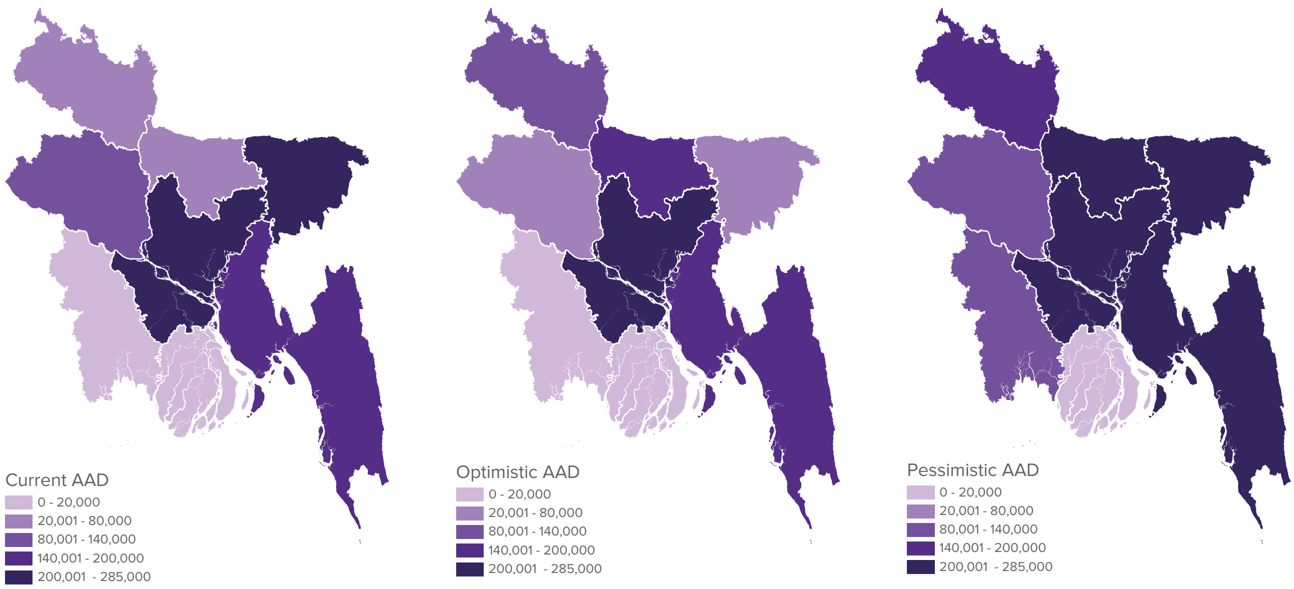
Under current climate conditions, displacement figures nearly triple from frequent events (e.g., a 5-year return period) to rare events (e.g., a 100-year return period).

This trend is also observed when analyzing the Probable Maximum Displacement (PMD) under long-term climate scenarios, for both optimistic and pessimistic scenarios. In the latter case, a 100-year riverine flood event may result in displacement figures that double under the optimistic scenario and triple under the pessimistic one (see Figure 9 in Figure Annex).

Under current climate conditions, a 50-year return period event, meaning a 2% chance of occurring in any given year, a 33% chance over the next 20 years, and a 64% chance over the next 50 years, could displace approximately 1.2 million people in Chittagong, 1.4 million in Dhaka, and 1.4 million in Sylhet.

Except for Khulna, and Barisal where the risk may decrease under optimistic scenario, in both Chattogram and Dhaka risk may increase by more than 35%. Under pessimistic scenario for both Chittagong and Dhaka the risk of riverine flood displacement reaches 2.8 million for a 50 year return period. In Sylhet 2.5 million people will be at risk.

Figure 4: Average Annual Displacement risk by riverine floods in Bangladesh under different climate scenarios



Storm surges

As a cyclone moves across an ocean, its winds push the water into a wall as it nears landfall, creating a storm surge. Impacts depend on coastal topography, the sea level rise and the tides. The risk of displacement enters uncharted territory with king tides, which occur when extreme weather events coincide with uncommonly high tides caused when the gravitational pull of the moon and the sun are aligned.[10] The current model does not account for tides or their potential impact on the population.

Findings from the model for storm surges show an AAD of around 778,000 people in Bangladesh. The results under different climate scenarios highlight a non-negligible influence of climate change. Both the optimistic and the pessimistic scenarios increase AAD values and may be multiply by 2.5 in the worst-case scenarios.

When downscaling the analysis to the district level, several notable trends emerge regarding how risk evolves under the two scenarios (see Figure 5). In most districts at risk for storm surges, the risk of displacement is projected to increase under the pessimistic scenario.

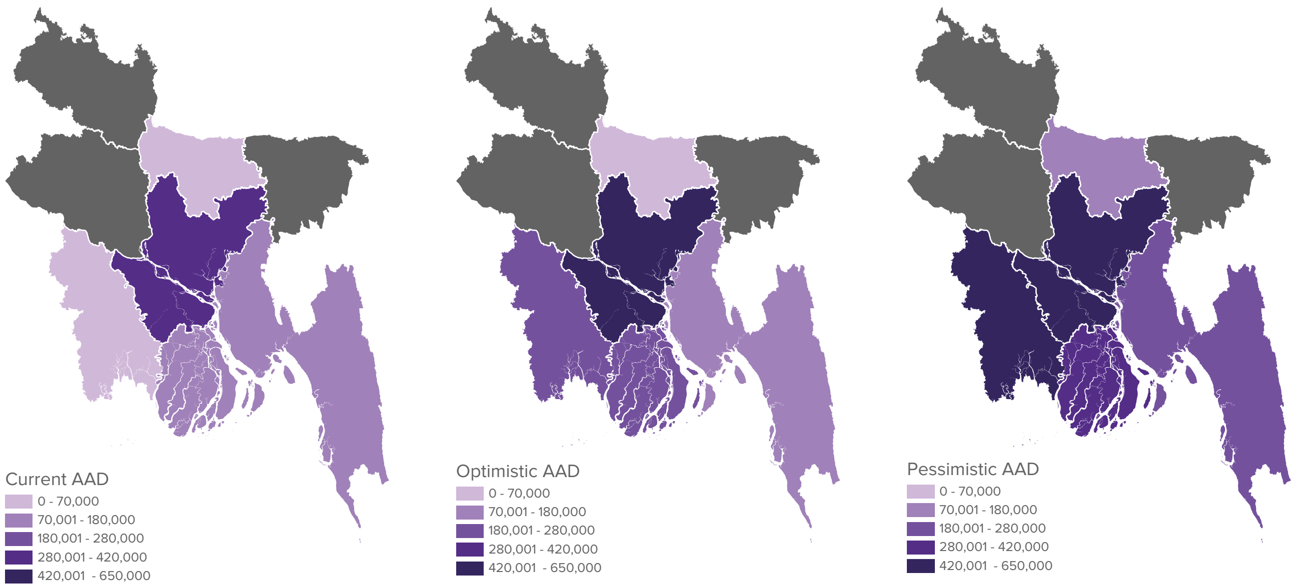
Although Dhaka is not located directly on the coast, it is significantly affected by the consequences of sea-level rise in Bangladesh, as most of the country lies below 10 metres above sea level.[11] As the most densely populated district in the country, Dhaka faces the highest current risk of displacement, with an estimated 379,000 people on average at risk. The risk of displacement may increase around 35% under optimistic scenarios to 70% under pessimistic scenarios.

In Khulna, the risk of displacement could increase several times over if the current population distribution remains unchanged. Under present climate conditions, more than 65,000 people are estimated to be at risk. In optimistic scenarios, this number could nearly quadruple to 260,000, and potentially increase sevenfold under the most pessimistic projections.

As highlighted in riverine floods risk section, while the Annual Average Displacement (AAD) reflects the average number of storm surges-induced displacements over a long time frame, it is not useful for understanding the risk of outlier events.

Under current climate conditions, a 50-year return period event, meaning a 2% chance of occurring in any given year, an 18% chance over the next 20 years, and a 39% chance over the next 50 years, could displace approximately 718,000 people in Dhaka and 375,000 people in Barisal. In more pessimistic scenarios, these numbers could by multiple by fivefold, reaching 2 million in Barisal. In Dhaka the risk may increase by more than 65% reaching 1.21 million (see Figure 10 in Figure Annex).

Figure 5: Average Annual Displacement risk by storm surges in Bangladesh under different climate scenarios



Heavy monsoon rains in Bangladesh. Seasonal flooding intensified by climate change continues to uproot communities across the country. © WFP/Mehedi Rahman

Cyclonic winds

Cyclones use warm water, moist air as fuel to gain strength, making Bangladesh highly vulnerable to cyclonic winds due to its location along the Bay of Bengal.[12] High winds can directly damage or destroy buildings and infrastructure, rendering homes uninhabitable and disrupting essential services like power and water. Even though evidence is limited, wind damage alone does not appear to be one of the primary triggers of displacement during cyclones. Roofs may be damaged, but the structural integrity of buildings often remains intact—though this depends on the type of construction and the severity of the impact in the affected area.

The analysis of displacement risk due to cyclonic winds in Bangladesh shows that three districts may be affected. Chittagong, Barisal, and Khulna could have average annual displacement (AAD) estimates of approximately 200, 50, and 25, respectively under current climate conditions (see Figure 6).

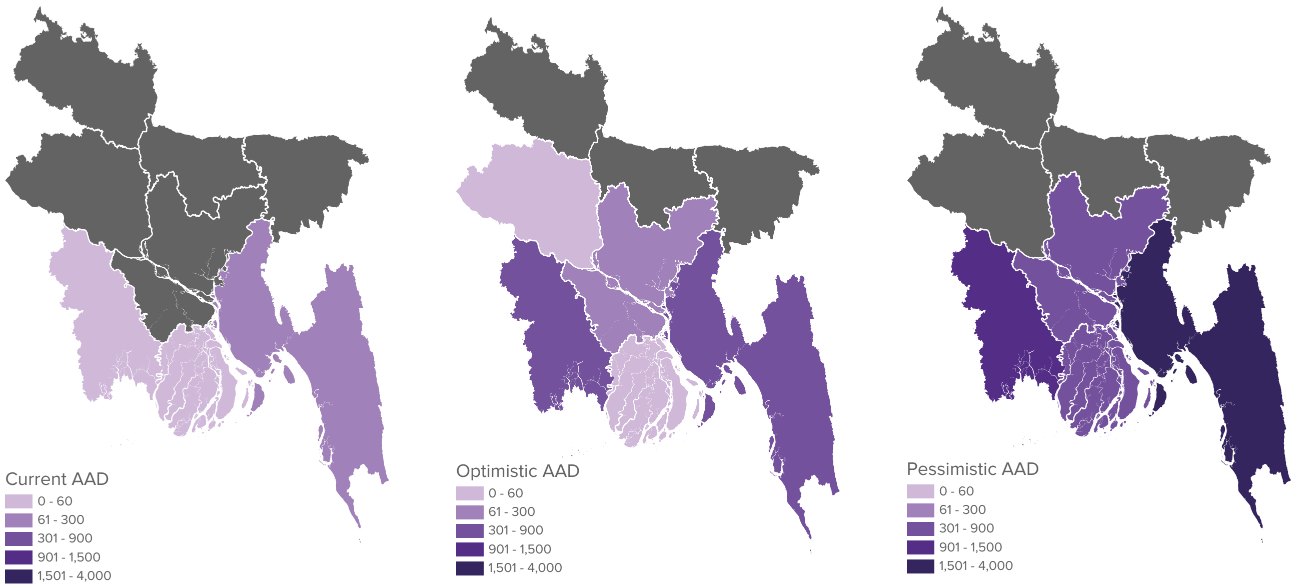
Under optimistic scenarios, the risk may double in Chittagong and increase significantly in Khulna, reaching up to 800 people. In these scenarios, Dhaka may also experience displacement linked to cyclonic risk, putting approximately 280 people at risk, whereas this was not the case under current climate conditions. In pessimistic scenarios, Chittagong appears highly exposed to severe cyclonic wind speeds that could trigger displacement, with the average annual displacement (AAD) potentially reaching 3,900 people.

As highlighted in riverine floods risk section, while the Annual Average Displacement (AAD) reflects the average number of cyclonic winds-induced displacements over a long time frame, it tends to mask potential outliers.

Our modelling approach was providing risk information for hazards with a greater return period of 250 years. A 250-year cyclone event usually represents a very intense storm, far stronger than what happens on average. Over a 30-year period, there's about a 12% chance of experiencing such an event in exposed area, and probability 0.4% chance it could happen in any single year.

In both Chittagong and Khulna, under the worst-case scenarios, a very intense cyclone may trigger around 30,000 displacements linked to cyclonic winds impact.

Figure 6: Average Annual Displacement risk by cyclonic winds in Bangladesh under different climate scenarios



A man walks along a beach in Kuakata, Bangladesh, after Cyclone Remal made landfall in 2024. Stronger cyclones are increasing displacement risk along the coast. © Munir Uz Zaman/AFP via Getty Images

Drought

Droughts are one of the most complex and one of the most catastrophic disasters, causing severe damage to agriculture and the economy. In Bangladesh, millions of hectares are vulnerable to annual drought[13] and drought can occur even in regions that typically receive adequate rainfall. Factors such as insufficient pre-monsoon showers, delayed onset of the rainy season, or an early withdrawal of the monsoon can contribute to drought conditions. Although there is no recorded evidence of drought-induced displacement in Bangladesh, such events are often small in scale, affecting only a few families, which makes them difficult to track and monitor accurately. To better assess drought-related displacement, our model incorporates economic, social, and environmental factors to refine risk estimates without much calibration for historical data.

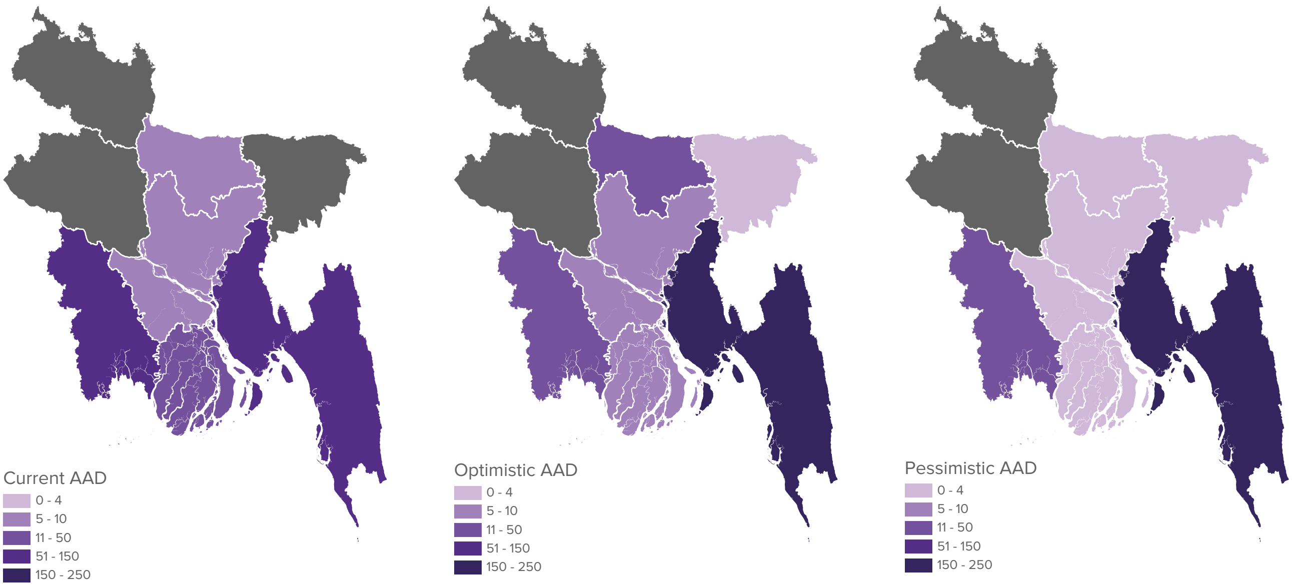
This comprehensive approach enhances understanding of displacement drivers and supports more effective resilience planning.

The analysis of drought displacement risk at a country level is relatively small and presents an Annual Average Displacement (AAD) value of around 300 people. The results under different climate scenarios do not show any major influence of climate change. Interestingly, the risk slightly decrease under the optimistic scenario and the pessimistic one, with 225 and 268 AAD, respectively.

When downscaling the analysis to the district level, no major trend emerges regarding how risk evolves under the two scenarios (see Figure 7). Chittagong and Khulna are most districts at risk for drought. For Chittagong, the risk of displacement is projected to increase slightly under both climate scenarios. In contrast, for Khulna, the risk may decrease fourfold under both the optimistic and pessimistic scenarios.

Looking at PMD, under current climate conditions, a 100-year return period drought event with a 1% chance of occurring in any given year and a 39% chance over the next 50 years could displace more than 5,000 people in Chittagong and 4,700 in Khulna. In both the optimistic and pessimistic scenarios, the numbers remain approximately the same for Chittagong, where climate change appears to have little impact on drought-related displacement. For Khulna, the drought displacement risk may also decrease under both scenarios, suggesting a potential reduction in risk in a changing climate (see Figure 11 in Figure Annex).

Figure 7: Average Annual Displacement risk by drought in Bangladesh under different climate scenarios



An internally displaced woman with disabilities in Bangladesh. People with disabilities are especially vulnerable during disasters and related displacement. © IFRC

Conclusion

Disaster displacement is one of the most significant humanitarian and development challenges we face in the 21st century.

The insights from probabilistic risk models underscore the need for proactive policy interventions to prevent and manage future displacement driven by natural hazards in a changing climate. They also provide insights into how and where that displacement may occur. To minimise the risk of displacement and its most adverse impacts, the government in Bangladesh and all actors managing disaster risk reduction can use this information to move beyond reactive responses to displacement events and adopt forward-thinking strategies that anticipate risks and build resilience in vulnerable communities.

Our study outlines an effort to create and apply a multi-hazards displacement risk model that utilizes novel methods for vulnerability assessment. The methodology gauges the potential displacement of individuals due to riverine floods, storm surges, cyclonic winds and drought.

The quantification of risk is expressed in terms of Average Annual Displacement (AAD) and Probable Maximum Displacement, calculated under current climate conditions as well as long-term projections based on both optimistic and pessimistic scenarios. This methodology, first applied in two small Pacific islands, Fiji and Vanuatu, was later scaled up to the regional level in the Horn of Africa before being implemented globally. The resulting outputs provide valuable insights into the proportion of housing rendered uninhabitable and the loss of livelihoods caused by floods and droughts, both of which can trigger displacement. We present outputs at Admin level 1 highlighting where the spatial risk pattern increases under projected conditions influenced by climate change, considering optimistic and pessimistic scenarios.

The model's results can be used to inform national and subnational disaster risk reduction measures, identify areas where large numbers of people could be made homeless by floods, and calculate evacuation centre capacities and the amount of investment needed to support displaced people. Through this report, we present some recommendations that can serve as a foundation for developing comprehensive policies and strategies to mitigate displacement risks associated with hazards highlighted in this report floods and protect the rights and wellbeing of affected populations.

Tangible steps must be reinforced to identify and target vulnerable populations who are at higher risk of displacement. Tailored strategies should be developed to protect their rights and well-being. Additionally, investment in flood-resistant infrastructure (riverine and storm surges) and improved building standards is essential to reduce displacement and property damage. Finally, continued advocacy for and implementation of climate mitigation measures remains crucial.

Data availability, technological advances and growing international recognition of the scale and increasing risk of disaster displacement mean the time is right for more and better-coordinated action to build on good practices and address the challenge of designing effective displacement risk models.

Further efforts are required to effectively quantify future hazard risks, especially with the dynamic background of evolving "riskscapes" in Bangladesh. The effectiveness of our efforts will naturally improve with the availability of additional data to refine and calibrate our models. This necessitates a comprehensive understanding of population and socioeconomic patterns, along with fluctuations in the frequency and intensity of hazards associated with climate change. To achieve this, we must leverage open-access data, refine terrain models for greater accuracy and acquire more hydrometeorological, and meteorological data. The risk of disaster-induced displacement is a global reality, present in every country. Now is the opportune time to demonstrate our collective commitment to the principle of leaving no one behind, particularly those already enduring the challenges of protracted and repeated displacement.

A boy stands along an eroding riverbank in Sirajganj District, Bangladesh. Severe riverbank erosion has destroyed thousands of homes and repeatedly displaced families, which is impacted to worsen as climate change accelerates. © IOM/Natalie Oren

Figure Annex

Figure 8: Map of Bangladesh by district

Figure 9: Probable Maximum Displacement per district for riverine flood

Legend

Low | | Medium | | High

By District	Current PMD50	Optimistic PMD50	Pessimistic PMD50
Barisal	119,000	5,400	315,000
Chittagong	1,200,000	1,700,000	2,800,000
Dhaka	1,500,000	2,000,000	2,900,000
Khulna	146,000	32,000	1,800,000
Mymensingh	457,000	844,000	1,200,000
Rajshahi	592,000	1,300,000	916,000
Rangpur	318,000	438,000	1,600,000
Sylhet	1,500,000	1,700,000	2,500,000

By District	Current PMD100	Optimistic PMD100	Pessimistic PMD100
Barisal	245,000	77,000	586,000
Chittagong	1,400,000	2,000,000	3,400,000
Dhaka	1,700,000	3,100,000	3,600,000
Khulna	181,000	59,000	2,500,000
Mymensingh	534,000	1,100,000	1,600,000
Rajshahi	674,000	1,500,000	1,100,000
Rangpur	405,000	519,000	1,900,000
Sylhet	1,800,000	2,200,000	3,500,000

Figure 10: Probable Maximum Displacement per district for storm surges

Legend

Low		Medium		High

By District	Current PMD50	Optimistic PMD50	Pessimistic PMD50
Barisal	375,000	1,100,000	2,000,000
Chittagong	206,000	422,000	790,000
Dhaka	718,000	1,000,000	1,200,000
Khulna	187,000	540,000	836,000
Mymensingh	90,000	120,000	124,000

By District	Current PMD250	Optimistic PMD250	Pessimistic PMD250
Barisal	4,700,000	5,500,000	5,900,000
Chittagong	3,200,000	4,300,000	5,200,000
Dhaka	3,300,000	4,400,000	5,500,000
Khulna	1,700,000	2,300,000	2,600,000
Mymensingh	249,000	367,000	501, 000

Figure 11: Probable Maximum Displacement per district for drought

Legend

Low		Medium		High

By District	Current PMD25	Optimistic PMD25	Pessimistic PMD25
Barisal	25	18	16
Chittagong	360	940	1,800
Dhaka	15	12	8
Khulna	330	150	140
Mymensingh	15	160	9
Sylhet	1	13	1

By District	Current PMD100	Optimistic PMD100	Pessimistic PMD100
Barisal	370	210	220
Chittagong	5,000	4,600	5,700
Dhaka	220	190	150
Khulna	4,700	1,700	2,200
Mymensingh	220	340	160
Sylhet	13	25	14

Methodological Annex

The true benefits of a probabilistic risk assessment are frequently misconstrued because it is regarded as a complex and challenging method to implement and follow, with a communication hurdle when presenting outcomes. A probabilistic disaster displacement risk profile must be seen as a diagnostic tool, because it offers insights into potential hazard occurrences and their consequences.

Such profiles cover all possible risk scenarios in a certain geographical area. Both low-frequency, high-impact events and high-frequency, low-impact events are considered. Their probability of occurrence, all elements of the risk equation (risk = hazard X exposure X vulnerability), and their variability and uncertainty ranges are all included (see Figure 12).

Events that have rarely been recorded but might occur more often under climate projections are thus also considered. This feature is particularly useful because climate change is increasing uncertainty about future hazard patterns. To be prepared, societies need to calculate the worst possible impact. Viewed through this lens, there is no valid alternative to a probabilistic analysis to address such uncertainty in a usable, quantitative way.

Displacement risk information, expressed in average annual displacement (AAD) and probable maximum displacement (PMD), is calculated at the subnational regions and aggregated at country level, allowing for a geographic and quantitative comparison within and between countries. These analyses and comparison exercises are an important step in risk awareness processes and key to pushing for risk reduction, adaptation and management mechanisms to be put in place.

The PMD curve illustrates the probability of a specific scenario leading to an estimated number of displacements. This likelihood is usually measured in terms of return period, which is often misunderstood. A return period is the average time interval in years that separates two consecutive events equal to or exceeding the given magnitude. The most common misconception is that an event with a 100-year return period will only occur once a century, when instead it means that it has an exceedance probability of 1 in 100, so events of the same or greater intensity happen once every 100 years on average. This does not preclude the possibility of several events with a 100-year return period happening within a century, or even the rare chance of consecutive events transpiring in consecutive years. Neither does it eliminate the possibility of an entire century passing without such an event occurring.

Our model assesses the risk of severe housing damage or destruction, as well as the loss of livelihoods for certain hazards such as droughts and floods, to estimate the likelihood of displacement. In essence, it focuses on the risk of medium- to long-term displacement and does not account for or model pre-emptive evacuations. This means the figures presented here are highly conservative. Our approach looks at people who may suffer the consequences of their homes becoming uninhabitable and who are forced to be displaced for weeks, months, or even years.

Using the similar approach of “catastrophe Modeling” CAT assessing economic losses associated with disasters (Average Annual Loss -AAL- and Probable Maximum Loss -PML-), we “humanised” the approach by looking, instead of the monitory value of residential building, how many people lives in it, **to estimate the probability of people getting displaced**. Our outputs are presented under two main metrics: Average Annual Displacement (AAD) and Probable Maximum Displacement (PMD) for each hazard type and downscaled at admin 1 resolution (see section - *Making sense of displacement risk metrics*).

Displacement risk from the four hazards is estimated using two distinct risk modeling framework, one from CIMA foundation for riverine floods and CLIMADA for the other hazards, each of which estimates human displacement resulting from the interplay of the hazard, exposure, and vulnerability data. This consistency allows for a comparative analysis of outputs across models.

Figure 12: The displacement risk equation

Displacement risk from **riverine floods** is assessed using the risk model developed by CIMA foundation, while displacement from **tropical cyclones** (winds) and **coastal floods** (storm surge and sea level rise) is calculated using the Python implementation of CLIMADA under the Weather and Climate Risks at ETH Zürich. Drought-related displacement is modeled using an earlier version of CLIMADA, implemented in Matlab, by United Nations Universities - Institute for Environment and Human Security.

Hazards

River flood hazard maps were generated using a climate-hydrology-inundation framework with bias-corrected CMIP6 projections from 15 global climate models. The Continuum hydrological model simulated river discharge, which was processed through the REFLEX inundation model to produce flood hazard maps. A synthetic 3,000-year event catalogue was created to improve risk estimates. (CIMA foundation)

To capture the spread of possible climate scenarios, we compared 15 models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP3b), which provides bias-corrected Coupled Model Intercomparison Project Phase 6 (CMIP6) climate scenarios for pre-industrial, historical, SSP1-RCP2.6, SSP3-RCP7.0 and SSP5-RCP8.5 conditions, in terms of temperature and precipitation rise in 2016. Temperature and precipitation trends proved to be highly correlated in the models considered, so we referred only to temperature trends to define representative scenarios, from which we selected, optimistic and pessimistic.

Coastal flood hazard maps were developed based on storm surges and sea-level rise (SLR) projections, considering future scenarios for 2050 and 2100 under SSP1-2.6 and SSP5-8.5. (Disaster Analytics for Society Lab - Nanyang Technological University - NTU Singapore)

Drought hazard conditions were analysed using the Standardized Precipitation Index (SPI_12), which measures long-term precipitation anomalies. Data from the Cordex dataset at a 0.22° resolution were used, incorporating RCP2.6 and RCP8.5 scenarios. Drought intensity and frequency were assessed for return periods of 10 to 100 years. (UNU-EHS – Climate Risk Analytics)

Tropical cyclone wind hazards. We used synthetic tropical cyclone event sets from the MIT model, downscaled from ERA-5 reanalysis data for historical periods and from nine GCMs for future climate scenarios (SSP2-4.5 and SSP5-8.5) for 2041–2060 and 2081–2100. Wind-driven impacts were modelled using the Holland (2008) parametric wind model, with maximum sustained wind speeds serving as the hazard intensity variable. Storm surge effects were categorized under coastal flooding, while rainfall impacts were excluded. (MIT - Weather and Climate Risks at ETH Zürich)

Exposure

We use the Global Building Exposure Model at 1km resolution globally to assess how different hazards impact communities and infrastructure. This model helps us understand which buildings and populations are most at risk from disasters like cyclones, floods, and droughts. By integrating high-resolution data on population, land use, and economic activity, we can better estimate potential displacement and improve disaster response planning. (The GIRI global building exposure model (BEM) - UNEP-GRID-Geneva-CDRI-IDMC).

Vulnerability

In hazard risk modelling, vulnerability is represented through impact functions, which estimate structural damage and displacement risk from hazards like tropical cyclones, floods, and droughts. We use CAPRA impact functions to assess building damage based on wind speed and flood depth, while a separate function estimates livelihood loss due to flooding in agricultural areas. (CAPRA - Comprehensive Approach to Probabilistic Risk Assessment: international initiative for risk management effectiveness and Rossi and al. A new methodology for probabilistic flood displacement risk assessment)

For drought-related displacement, our model considers economic, social, and environmental factors to refine risk estimates at national and subnational levels. This approach ensures a comprehensive understanding of displacement drivers and informs more effective resilience planning.

This risk assessment considers a large number of possible scenarios, their likelihood, and the resulting damage to housing, while also accounting for livelihood damages, mainly from medium- to large-scale events. Small and recurrent events still require daily monitoring of empirical information to understand and capture the true scale of displacement risk by different triggers.

For this iteration, we did not account for changes in exposure between current and future scenarios, although factors such as population growth and distribution—such as rapid urban sprawl reducing natural areas that absorb floodwater—may significantly alter the future "riskscape." However, for drought-related displacement, we explore potential changes in population distribution and dynamics over time using United Nations population projections for 2050 and 2100.

It is important to note that the results exclude individuals involved in pre-emptive evacuations. Our outputs focus on people at risk of medium- to long-term displacement, primarily due to severe damage to homes. For floods, we also explore the risk of loss of livelihoods, incorporating a complex process to avoid double-counting individuals who may experience both housing and livelihood loss in the same scenario. However, since droughts rarely damage built environments, we focus on how they impact agriculture, undermining livelihoods and forcing communities into displacement situation in search of alternatives.

Lastly, even with the use of more accurate exposure layers at a 1 km x 1 km resolution, the resolution of certain hazard datasets did not allow for proper subnational displacement risk assessments. The outputs should be viewed as tools to raise awareness and guide further discussions on disaster risk reduction investments centered on internal displacement. The model and its current resolution are not suitable for informing land use or urban planning decisions. Additional efforts are needed to develop more accurate and higher-resolution data on hazards and exposure, as well as customized vulnerability assessments that incorporate coping mechanisms from different regions within the country. This would enable the design of more detailed and effective measures to actively reduce displacement risk at the local level. Currently, the outputs are intended to support discussions at the national level.

IDMC has been working with numerous partners since the mid-2010s to put our data to use in estimating disaster displacement risk. Collaborating with diverse and respected partners allows us to use the most up-to-date data and methodologies for various components of displacement risk and apply strict scientific rigour and quality assurance in our models.

Our current consortium of partners includes the CIMA Foundation, ETH-Zurich's Weather and climate risk group, the Nanyang Technological University - NTU Singapore, the Potsdam Institute for Climate Impact Research (PIK), The United Nations University's Institute for Environment and Human Security (UNU-EHS).

Boats moored along the shoreline in Kurigam District, Bangladesh, after the historic 2019 floods. Extreme river flooding destroyed homes and farmland, driving large-scale internal displacement. © UNOCHA

Endnotes

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Flooded rice fields in Cox's Bazar District, Bangladesh. Heavy monsoon rains regularly inundate farmland, threatening livelihoods and food security and heightening the risk of disaster displacement. © NRC/Ingrid Prestetun

Every day, people flee conflict and disasters and become displaced inside their own countries. IDMC provides data and analysis and supports partners to identify and implement solutions to internal displacement.

Join us as we work to make real and lasting change for internally displaced people in the decade ahead.

iDMC internal displacement monitoring centre

The Internal Displacement Monitoring Centre
La Voie Creuse 16, 1202 Geneva, Switzerland
+41 22 552 3600 | info@idmc.ch

internal-displacement.org
x.com/IDMC_Geneva
youtube.com/c/InternalDisplacementMonitoringCentreIDMC
linkedin.com/company/idmc-geneva