Institute for Economics & Peace
Analysing ecological threats, resilience & peace

ECOLOGICAL THREAT REPORT 2023

- Results & Trends
- Ecological Threats
- Conflict & Climate
- Megacities & Migration

Institute for Economics & Peace

Quantifying Peace and its Benefits

The Institute for Economics & Peace (IEP) is an independent, non-partisan, non-profit think tank dedicated to shifting the world's focus to peace as a positive, achievable, and tangible measure of human well-being and progress.

IEP achieves its goals by developing new conceptual frameworks to define peacefulness; providing metrics for measuring peace; and uncovering the relationships between business, peace and prosperity as well as promoting a better understanding of the cultural, economic and political factors that create peace.

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Contents

EXECUTIVE SUMMARY

This is the fourth edition of the Ecological Threat Report (ETR), which analyses ecological threats in 221 independent states and territories. Produced by the Institute for Economics & Peace (IEP), the report covers 3,594 sub-national areas which account for 99.99 per cent of the world's population. The ETR assesses threats relating to food insecurity, water risk, natural disasters, and demographic pressure.

The research takes a multi-faceted approach by analysing ecological threats at the national, subnational, and city level, while also assessing the threats against societal resilience and levels of peace. Comparing ecological threats against societal resilience enables IEP to identify the global regions, countries, and subnational areas most at risk of an ecological disaster, both now and into the future.

The key finding from the 2023 ETR is that without concerted international action, current levels of ecological degradation will substantially worsen, thereby intensifying a range of social issues, such as malnutrition and forced migration. Current conflicts will escalate and multiply as a result, creating further global insecurity. IEP estimates that by 2050, 2.8 billion people will reside in countries facing severe ecological threats, compared to 1.8 billion in 2023, with 1.1 billion of these people living in countries with low societal resilience.

A nexus of interrelated challenges sustain and feed off each other. Systemic effects compound, ensnaring countries in conflict traps that are difficult to escape. This nexus is explored in this report, highlighting both the significant impact of high population growth, ecological collapse, and weak societal resilience, and their relationship to conflict. These are issues that need to be addressed systemically. Europe and North America are the only two regions where no countries currently face a severe ecological threat.

Of the 221 independent states and territories covered in the ETR, 66 face at least one severe ecological threat. Almost half of the countries in the ETR face at least one high level ecological threat, but not every region is equally affected. Ecological threats are considerably higher in sub-Saharan Africa than any other region. Almost all of the 103 sub-national areas that face severe threats across all four domains are in sub-Saharan Africa. Similarly, of the 30 hotspot countries which face severe ecological threats and have low levels of societal resilience, 19 are in sub-Saharan Africa. The four most at risk countries are Ethiopia, Niger, Somalia and South Sudan.

Food insecurity remains a major global issue. Global food prices have fluctuated significantly in recent years and are currently 33 per cent higher than they were in 2016. There are currently 42 countries facing severe food insecurity, and almost four billion people live in areas with high or severe food insecurity, with the majority in sub-Saharan Africa. As many as five billion people could be living in areas with high or severe food insecurity by 2050.

Water risk is also a significant ecological threat, and is getting worse. Approximately two billion people globally do not have regular access to safe drinking water. There are 77 countries where the level of water risk is high or severe, meaning that over 20 per cent of the population live in areas without access to safe drinking water. There are now 25 countries where over 80 per cent of the renewable water supply is used, up from 17 just five years ago. While water risk is highest in sub-Saharan Africa, it is also increasing in the Middle East and North Africa, Russia and Eurasia.

The risk posed by natural disasters continues to increase. Over 1.8 billion people live in areas that face severe risk from natural disasters, and there is a strong chance that more than five per cent of the population will be severely impacted by a devastating natural hazard. There are 44 countries with both a high risk of natural disasters, and low resilience. The impact of extreme weather events is compounded when countries have low levels of resilience. The inability of many countries to deal with the impact of natural disasters has led to a greater need for disaster relief funding. In 2022, 35 per cent of total funding from the UN Central Emergency Response Fund (CERF) was dedicated to providing aid in the aftermath of natural disasters, compared to just 17 per cent a decade ago.

Increasing demographic pressure compounds the risks caused by other ecological threats, as rapid population growth places increasing strain on public resources and societal resilience, particularly in areas already at risk and have low levels of peacefulness. Over 40 per cent of the subnational areas in the world are expected to record population growth of more than 20 per cent by 2050. Nearly half of this population growth will occur in countries with very low levels of peacefulness. The 40 least peaceful countries in the world will have an additional 1.3 billion people by 2050, at which point they will account for just under half of the total world population. Sub-Saharan Africa's population is predicted to rise to 2.2 billion or 60 per cent by 2050. The growth is so high that the total population of people aged 15 or under in the region is projected to be higher than the entire population of Europe.

Ecological threats increase the risk of conflict, both now and in the future. A 25 per cent increase in food insecurity, as measured by the ETR, increases the risk of conflict by 36 per cent. Additionally, the same increase in water risk and natural disasters increases the risk of conflict by 18 per cent and 21 per cent respectively. The impact on conflict risk is greatest in areas with a history of conflict, a lack of resilience, and weak institutions.

Ecological threats have the greatest impact on conflict in regions like the Sahel, which face major deficiencies in governance and the rule of law, high levels of poverty, and high climate variability. These areas are especially prone to conflict in the aftermath of an ecological shock like a flood, drought, or other natural disaster, especially where long-term climate variation is an issue. The magnitude of this impact will increase as the long-term effects of climate change start to take hold.

However, the impact of climate change on conflict should not be overstated. The exact mechanisms by which climate change will lead to increased conflict risk are not yet fully understood. Some conflicts which have been attributed to climate change may have been the result of weak institutions and pre-existing conflict over resources. For example, recent analysis of conflict around Lake Chad has argued that political mismanagement of water resources, rather than changes in the lake itself, has played the bigger role in fuelling conflict.

As intensifying ecological threats lead to more conflict, the risk of an increase in forced displacement rises. The number of forcibly displaced people in the world now stands at over 108 million. Between 2020 and 2023, 22 per cent of refugees moved to countries with higher average levels of water risk, and 18 per cent moved to countries with higher levels of food insecurity.

A large majority of displaced people are likely to end up in cities. More than 60 per cent of refugees and 80 per cent of internally displaced people have moved to cities. The proportion of the world living in urban areas is set to rise from 54 to 70 per cent by 2050. Much of this growth is happening in 'megacities', urban areas of more than ten million people. Many of the megacities that are growing rapidly will not be able to cope with the rising population. Megacities with low tax revenue will not be able to build appropriate infrastructure, provide security, schooling or jobs. The increasing strain on city resources, will likely lead to an increase in pollution, urban unrest, and the number of people living in informal settlements. The two countries with the most megacities with high growth, low per capita income and low societal resilience are Nigeria and Democratic Republic of the Congo.

Ecological threats, societal resilience and low levels of peacefulness will not be resolved without concerted international action. The 2023 ETR includes many policy recommendations aimed at supporting local communities to improve water capture, agricultural yields and resilience. Some of the key recommendations include:

- Building resilience in a way that is holistic and broadens the range of actors involved. International agencies need new integrated structures that operate systemically, combining health, food, water, refugee relief, finance, agricultural, development and other functions.

- Empowering local communities. Community-led approaches to development and human security result in more effective programme design, easier implementation, and higher levels of sustainability.

- Many innovative programs build water resilience. Sand dams in Kenya, chlorine dispensers for safe water in Malawi and engineered wetlands in China provide examples of programs that build water resilience, cheaply and effectively.

- Farmer Managed Natural Regeneration (FMNR), has regenerated millions of hectares of degraded land in Africa and has exceptional potential, due to the low cost of implementation and has the potential to improve the lives of tens, if not hundreds of millions of people.

In summary, ecological threats will continue to create humanitarian emergencies, increase conflict and result in forced migration, unless there is a sustained effort to reverse the current trend. Ecological threats are becoming more pronounced and affect more people than ever. Building resilience to these threats will require substantial investment now and into the future.

> "Increasing demographic pressure compounds the risks caused by other ecological threats, as rapid population growth places increasing strain on public resources and societal resilience, particularly in areas already at risk and have low levels of peacefulness.

KEY FINDINGS

SECTION 1: RESULTS AND TRENDS

- Of the 221 independent countries and territories in the ETR, 66 face at least one severe ecological threat.
- Forty-five per cent of the countries covered in the ETR face either high or severe threat level.
- The number of people living in countries facing at least one severe threat will increase significantly in the next 50 years. IEP estimates that by 2050, 2.8 billion people will reside in countries facing severe ecological threats, compared to 1.8 billion in 2023. Most of the increase will be in sub-Saharan Africa.
- By 2050, sub-Saharan Africa's population is predicted to rise to 2.2 billion, an increase of over 60 per cent, which will dramatically increase pressure on existing food and water supplies.
- A strong statistically significant relationship exists between increases in violence and ETR scores for food, water, natural disasters and population. There is no statistically significant relationship between militarisation and any of the ETR domains.
- The ETR also measures ecological threat at the subnational level, across 3,594 subnational administrative areas. Around 38 per cent of these areas are facing at least one severe ecological threat.
- There are 103 sub-national areas that face severe levels of ecological threat in all four domains. 217 million people live in these areas, almost all of them in sub-Saharan Africa.
- 1.1 billion people live in 30 countries that face severe ecological threats and have extremely low societal resilience.
- These hotspot countries are clustered in three regions: sub-Saharan Africa, which has 19 countries with at least one hotspot area, the Middle East and North Africa (MENA) which has five countries with a hotspot area, and Asia-Pacific, which has two countries with a hotspot area.
- Four subnational areas in Ethiopia and Niger face extreme threats in all four domains. There are 69 million people who live in these four areas.
- The four most at-risk countries are all in sub-Saharan Africa: Ethiopia, Niger, Somalia and South Sudan.
- Europe and North America are the only two regions where no countries face any severe or high ecological threats across any of the four domains.
- Countries with very low levels of Positive Peace have a fatality rate seven times higher than those with very high levels of Positive Peace after experiencing a natural disaster.
- Angola, DRC, Libya, Iraq and Timor Leste all have fossil fuel income that are more than 25 per cent of GDP. They all also face substantial ecological threats and have low societal resilience. They are the countries most likely to face economic challenges from the green energy transition.
- These countries could face up to 60 per cent loss of their GDP between 2023 and 2040.

SECTION 2: ECOLOGICAL THREATS

- Food Insecurity remains a major issue globally. The Global Food Price Index is currently 33 per cent higher than in 2016, after successive increases of 35 per cent following COVID, and then a further 18 per cent following the Russian invasion of the Ukraine.
- 42 countries face severe food insecurity. Surveys from these countries show that more than 65 per cent of the population have been unable to afford food for their family at some point in the past year.
- More than one billion people in sub-Saharan Africa live with high or severe levels of food insecurity. This number is expected to increase to almost two billion by 2050.
- 35 of the 52 countries and territories in sub-Saharan Africa suffer from extreme food insecurity. 81 per cent of people suffering from extreme food insecurity globally live in sub-Saharan Africa.
- In sub-Saharan Africa 62 per cent of the population live in areas with high or severe levels of food insecurity.
- Food insecurity is more likely to occur in areas with small monoculture farms that depend on the sale of cash crops.
- Water security is a key driver of conflict, with water-related violent incidents exhibiting a threefold increase on average since 2000.
- Globally, there are 46 countries where the level of water risk is severe, and a further 31 countries where the level of water risk is high. This is where more than 20 per cent of the population does not have access to clean drinking water.
- Two billion people live in areas without access to safe drinking water.
- The number of countries using more than 80 per cent of their renewable water supply for irrigation, livestock, industry, and domestic purposes has risen from 17 in 2019 to 25 in 2023. Most of these countries are located in sub-Saharan Africa and MENA.
- By 2040, MENA is projected to have the same water stress as sub-Saharan Africa.
- Water scarcity is expected to worsen in numerous countries in the Russia and Eurasia region by 2040. This could have a significant impact on agriculture in the region.
- Over 1.8 billion people live in subnational areas at severe risk from natural disasters, defined as a strong chance that over five per cent of the population will be impacted by a devastating natural hazard.

KEY FINDINGS

- When countries lack resilience, natural hazards, such as earthquakes or floods, are more likely to become natural disasters. There are 44 countries with both a high risk of natural disasters, and low resilience. These countries are home to more than four billion people.
- Thirty-five per cent of total funding from the UN Central Emergency Response Fund (CERF) was dedicated to aiding in the aftermath of natural disasters in 2022, compared to just 17 per cent a decade ago.
- CERF pledged almost $200 million USD to aid 21 countries following a natural disaster in the first seven months of 2023, surpassing the yearly total for eight of the past ten years.
- Demographic pressure poses a significant ecological threat in many regions of the world. Over 40 per cent of the subnational areas in the 2023 ETR are expected to record population growth of at least 20 per cent between now and 2050.
- The bulk of this population increase is likely to occur in countries with low levels of peacefulness. Nearly half the population of the world is projected to be living in countries with very low levels of peacefulness, as measured by the GPI, by 2050.
- The 40 least peaceful countries will have an additional 1.3 billion people by 2050, at which point they will account for just under half of the total world population.
- Most countries in the world are transitioning to stable or contractionary population structures, as the number of young people relative to the number of old people continues to decline.
- Sub-Saharan Africa is still expected to increase its population by just under 62 per cent by 2050, from 1.3 billion to 2.2 billion people.
- Total youth population growth in sub-Saharan Africa is so high that the number of people aged 15 or under in the region is projected to be higher than the entire population of Europe by 2050.

SECTION 3: CONFLICT, CLIMATE, AND ECOLOGICAL THREATS

- The impact of carbon-induced climate change is likely to accelerate over the next 80 years. Data on the relationship between climate change and conflict is limited but will increase in the coming decades.
- By contrast, the relationship between ecological threats and conflict is much clearer. The combination of seasonal and long-term climate changes, short-term ecological threats, a history of conflict, a lack of resilience and weak institutions leads to an increased risk of conflict.
- Shifts in ETR scores are associated with increased risk of conflict. A shift in indicator scores of 25 per cent for food insecurity, natural disasters, and water risk increases the risk of conflict by 36 per cent, 21 per cent, and 18 per cent respectively.
- Ecological threats have the biggest impact on conflict in regions like the Sahel, which face major deficiencies in governance and rule of law, high levels of poverty and short-term climatic variations.
- The primary way that ecological threats increase conflict is by increasing competition for resources. However, countries with high levels of resilience and strong institutions are better able to deal with increased resource competition.
- Food insecurity is strongly linked to armed conflict. Areas of high food production are often also areas of significant conflict.
- Ecological shocks that damage livelihoods can increase opportunities for armed extremist groups to recruit new members
- The transition zone in the Sahel accounts for 7.6 per cent of the total land mass, but just under 16 per cent of total deaths. A transition zone lies between arid landscapes and areas with adequate rainfall.
- Conflict over goods from the global commons like fisheries is increasingly common as demand increases and effects of climate change affect ocean ecology. This is particularly acute during climatic extremes like El Nino events.
- Interstate conflict becomes more likely following rising temperatures or rainfall shocks, especially where states stand to lose from existing agreements on water sharing.
- The impact of climate change on conflict can be overstated compared to the impact of political instability. For example, recent analysis of lake Chad, has argued that political mismanagement of water resources has played the bigger role in fueling conflict.

KEY FINDINGS

SECTION 4: MEGACITIES AND MIGRATION

- There are currently 33 megacities in the world, meaning cities with a population of ten million or more. By 2050, there are projected to be at least 50.
- The percentage of people globally living in urban areas is expected to grow from 54 per cent to 70 per cent by 2050. The number of people living in cities will grow by 2.5 billion by 2050.
- The three largest megacities in the world in 2050 are expected to be Mumbai, Delhi and Kinshasa with populations of 42, 36, and 35 million respectively.
- More than 60 per cent of the world's current megacities are in low or very low peace countries. 268 million people live in megacities with very low peace. There is a significant negative correlation between projected megacity growth, and their level of peacefulness.
- While the percentage of people living in informal settlements or slums has fallen in most low-income countries, it has increased in fragile and conflict affected situations (FCAS). Nearly 55 per cent of the urban population in FCAS areas live in informal settlements.
- Most of the countries with the biggest growth in cities do not have the financial resources to manage the growth, with per capita income being lowest in Nigeria and the Democratic Republic of the Congo. Cities in these countries are less likely to be able to cope with the demand for services generated by such rapid population growth.
- Urban expansion can have a detrimental effect on its surrounding areas. Total global cropland is forecast to shrink by 1.8 to 2.4 per cent by 2030 because of increasing urbanization.
- Most growth in urbanisation has exacerbated many existing environmental, social, political and economic issues, including higher concentrations of pollution, more pronounced socio-economic differences and overwhelming existing infrastructure.
- In 2019, the five most air polluted cities all had readings of more than 16 times the WHO recommended annual limit; Lahore recorded 25 times, Kabul 24 times, Hetian Shi 23 times, Hapur 22 times, and Agra 21.9 times. All five cities are in Asia.
- Of the 20 most polluted cities only three are not in India or China.
- Most of the world's megacities are in countries with low levels of peacefulness. Of the 33 megacities 21 are in countries with low or very levels of peacefulness.
- Most of the world's megacity growth will take place in Africa and Asia. Eight of the ten largest megacities will be from these regions in 2050.
- Megacities in Africa face significant environmental challenges. Of the ten largest megacities in the region, nine are facing at least one severe ecological threat, other than population growth.
- Migration and displacement will be major issues for megacities in the near future. The number of forcibly displaced people in the world now stands at over 108 million.
- Most refugees and displaced people move into cities. More than 60 per cent of all refugees and 80 per cent of internally displaced people move to cities.
- The ETR data reveals that a significant portion of illegal crossings between 2020 and 2022 originated from countries facing severe food and climate insecurity.

1

Results and Trends

KEY FINDINGS

- Of the 221 countries and territories in the ETR, 66 face at least one severe ecological threat.
- Forty-five per cent of the countries covered in the ETR face either high or severe threat level.
- The number of people living in countries facing at least one severe threat will increase significantly in the next 50 years. IEP estimates that by 2050, 2.8 billion people will reside in countries facing severe ecological threats, compared to 1.8 billion in 2023. Much of this increase will be in sub-Saharan Africa.
- By 2050, sub-Saharan Africa's population is predicted to rise to 2.2 billion, an increase of over 60 per cent, which will dramatically increase pressure on existing food and water supplies.
- A statistically significant relationship exists between increases in violence and ETR scores for food, water, natural disasters and population. There is no statistically significant relationship between militarisation and any of the ETR domains.
- The ETR also measures ecological threat at the subnational level, across 3,594 subnational administrative areas. Around 38 per cent of these areas are facing at least one severe ecological threat.
- There are 103 sub-national areas that face severe ecological threats in all four domains. 217 million people live in these areas, almost all of them in sub-Saharan Africa.
- 1.1 billion people live in 30 countries that face severe ecological threats and have extremely low societal resilience.
- These hotspot countries are clustered in three regions: sub-Saharan Africa, which has 19 countries with at least one hotspot area, the Middle East and North Africa (MENA) which has five countries with a hotspot area, and Asia-Pacific, which has two countries with a hotspot area.
- The four most at-risk countries are all in sub-Saharan Africa: Ethiopia, Niger, Somalia and South Sudan.
- Four subnational areas in Ethiopia and Niger face extreme threats in all four domains. There are 69 million people who live in these four areas.
- Europe and North America are the only two regions where no countries face any severe or high ecological threats across any of the four domains.
- Countries with very low levels of Positive Peace have a fatality rate seven times higher than those with very high levels of Positive Peace after experiencing a natural disaster.
- Angola, DRC, Libya, Iraq and Timor Leste all have fossil fuel income that are more than 25 per cent of GDP. They all also face substantial ecological threats and have low societal resilience. They are the countries most likely to face economic challenges from the green energy transition.
- These countries could face a loss of up to 60 per cent of their fossil fuel rents between 2023 and 2040.

Overview

The Ecological Threat Report (ETR) is a comprehensive, data-driven analysis covering 3,594 sub-national areas across 221 countries and territories. It covers 99.99 per cent of the world's population and assesses threats relating to food insecurity, water risk, demographic pressures, and natural disasters.

This report identifies countries that have the highest risk, both now and in the future, of suffering from major disasters due to the ecological threats they face, the lack of societal resilience, and other factors. These countries are also the most likely to suffer from conflict.

The 2023 ETR aims to provide an impartial, data-driven foundation for the debate about ecological threats facing countries and sub-national areas and to inform the design of resilience-building policies and contingency plans.

The world is facing many instances of instability related to ecological threats. In 2022, natural hazards resulted in 32.6 million people being displaced across 151 countries.[1]

Rapid population growth and food insecurity in regions, such as sub-Saharan Africa and parts of MENA have been stressors of socio-political instability for the past fifty years or more. Water scarcity and rapidly growing populations in the Lake Chad region are exacerbating preexisting political and social instabilities, in turn increasing stress on already scare resources.[2] The clashes between Iran and Afghanistan regarding water distribution in the Helmand River and Hamun Lake escalated to conflict along the border in 2023, resulting in deaths on both sides is an example of this risk.[3]

While changes in methodology make it difficult to compare ETR scores across years, some similarities and patterns persist from year to year. Many of the same countries continue to face extremely severe ecological threats as in previous years, with Afghanistan, Mozambique, and Madagascar consistently ranking among the countries with the highest ecological threats. Sub-Saharan Africa and South Asia are the regions with the highest ETR scores over time.

The Sahel region faces numerous social, political and economic vulnerabilities and holds the world's highest concentration of hotspot countries. The region has high rates of conflict and terrorism. Seven of the ten countries within the Sahel are classified as "hotspots", meaning they have low levels of resilience and face at least one severe ecological threat: Cameroon, Chad, Guinea, Mali, Mauritania, Niger and Nigeria. Many of these areas are already experiencing armed conflict.

The balance between human activity and the planet's ecology is coming under increasing stress. As many as 1.8 billion people live in areas with limited access to clean drinking water. This figure is projected to rise to 2.8 billion by 2050. With the global population expected to grow by around one-quarter over the next 30 years, water shortages, food insecurity, and the severity of natural disasters are likely to substantially increase.

Looking forward, climate change will likely act as a threat multiplier, potentially exacerbating competition, and tensions among groups and countries with inadequate resources and low resilience. The number of natural hazards, including floods and droughts, has tripled over the last four decades and is likely to continue growing.[4] The latest IPCC report projects more extreme fires and floods, and longer droughts.[5] These ecological disasters lead to mass displacement as individuals search for basic security. For example, when unprecedented precipitation from Storm Daniel converged with inadequate maintenance of dams, catastrophic flooding occurred in Derna, Libya. It is estimated that the flood killed as many as 20,000 and displaced over 30,000 people, sweeping at least a quarter of the city into the Mediterranean Sea.[6,7]

With the global population continuing to increase, rising consumption expands humanity's ecological footprint. As a result, the effects of ecological catastrophes are set to become more pronounced. While mitigation strategies are available, they are substantially underfunded, and the damage will be irreversible.[8] These ecological factors will interact, compounding the pressures on many countries. These challenges will have an adverse effect on existing social and political structures. Recent examples of forced mass migration show the impact of negative shocks often extend well beyond national and even continental boundaries. Drought in the Horn of Africa has displaced nearly two million in Ethiopia, South Sudan and Somalia, with nearly 200,000 people crossing borders into similarly drought-stricken areas in Kenya and Ethiopia.[9] Additionally, record-breaking wildfires across Canada have also demonstrated the impact of ecological threats extending beyond borders.[10] Smoke from the wildfires caused air quality alerts to be issued in the United States, particularly in Northeastern and Midwestern cities like New York, Cincinnati, and Chicago, ultimately reaching 32 states.[11]

The 2023 ETR aims to help refine the debate on the linkages between ecological change and peacefulness. The ETR also underlines how societies can create resilience through building Positive Peace and using systems analysis approaches to better understand the dynamics of their societal and ecological systems, as described in Box 1.1.

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BOX 1.1

An introduction to Positive Peace, Resilience and Systems Thinking

Positive Peace is defined as the *attitudes, institutions and structures that create and sustain peaceful societies*. It was first conceptualised in the 1960s and empirically derived by IEP in 2012 with the development of the Positive Peace Index (PPI).

Positive Peace is the social, economic and governance factors that create highly functional societies, including peace and resilience. Positive Peace is also statistically connected to many other things considered important, including higher GDP growth, stronger measures of well-being, and better performance on the ecology and better developmental outcomes. Countries that perform well in Positive Peace tend to operate with higher levels of peace as measured by the GPI. They also tend to improve more rapidly than their peers in the GPI ranking. Research has shown that a country that enjoys high levels of Positive Peace is more capable of shielding its population from the immediate impacts of adverse shocks, including droughts, floods and earthquakes; and recovers more quickly in their aftermath. Thus, Positive Peace is often seen as a gauge of socio-economic resilience.

Nations operate according to the principles of societal systems. This means social, economic and political developments mutually affect one another, and it is difficult, if not impossible, to identify unique causes of events and trends. Another feature of social systems is that their internal structure may change depending on the severity of a shock. If a system is hit by a weak shock, it can respond without changing its internal configuration. For example, if a country is impacted by a mild economic recession, authorities will just need to respond with palliative measures that will not alter the structure of the economy or the fabric of society.

However, if a system is impacted by a high severity shock, or if the system has a low degree of resilience, the disruption may cause ruptures in the system's internal configuration. For example, there are many instances of nations that descended into a state of social disarray in 2020 and 2021 because of the COVID-19 pandemic and global recession. The Global Peace Index (GPI) 2022 highlights that during the pandemic, global peace deteriorated. This period placed heightened stress on pre-existing political and economic tensions in many countries. For example, Lebanon continues to grapple with deteriorating economic conditions and political instability triggering thousands of demonstrations nationwide. These events caused a reconfiguration of the political system. In Sri Lanka, violence demonstrations erupted in early 2022 in response to daily power cuts and shortages of basics such as fuel, food and medicine, resulting in the eventual resignation of both the President and Prime Minister. The system adjusted by seeking IMF loans and debt forgiveness as well as citizens adjusting their purchases and daily routines.

The threats assessed in the ETR can generate severe shocks to nations. A country's ability to cope will depend on the severity of the shock and the levels of socio-economic resilience. In nations with low socio-economic resilience, the shocks can trigger tumultuous breakdowns in their internal structure. This can result in frayed international relations, growing risk of conflict, forced displacement of persons both internal and cross-border, and a fertile environment for recruitment into radical militant organisations.

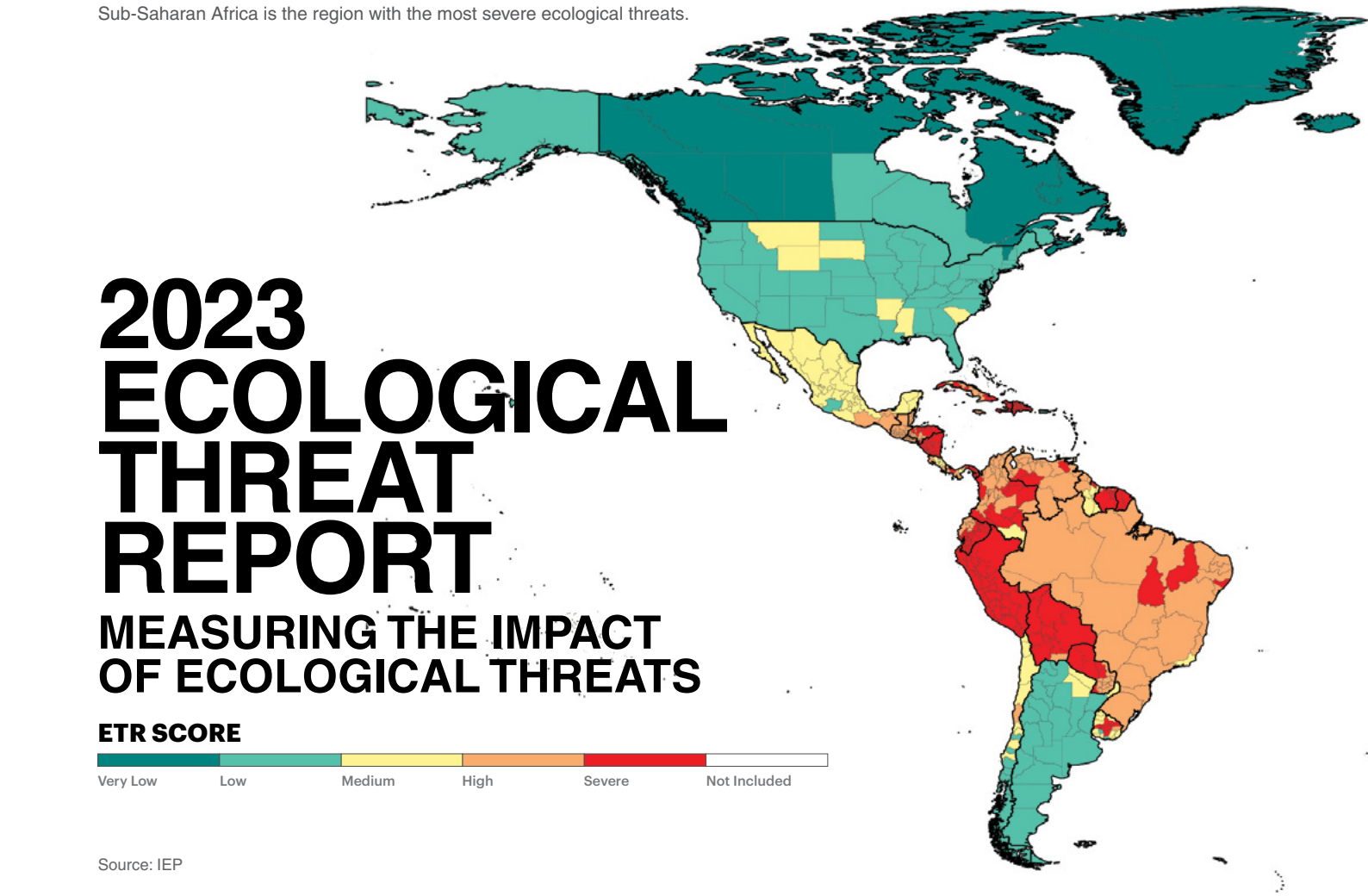
The concept of Positive Peace is discussed in more detail in the section 'Positive Peace and Hotspots' below. A more in-depth exposition is found in the Positive Peace Report 2022 **(https://www.visionofhumanity.org/)**.

Methodology and Results

FIGURE 1.1

Ecological Threat Report scores, 2023

Sub-Saharan Africa is the region with the most severe ecological threats.



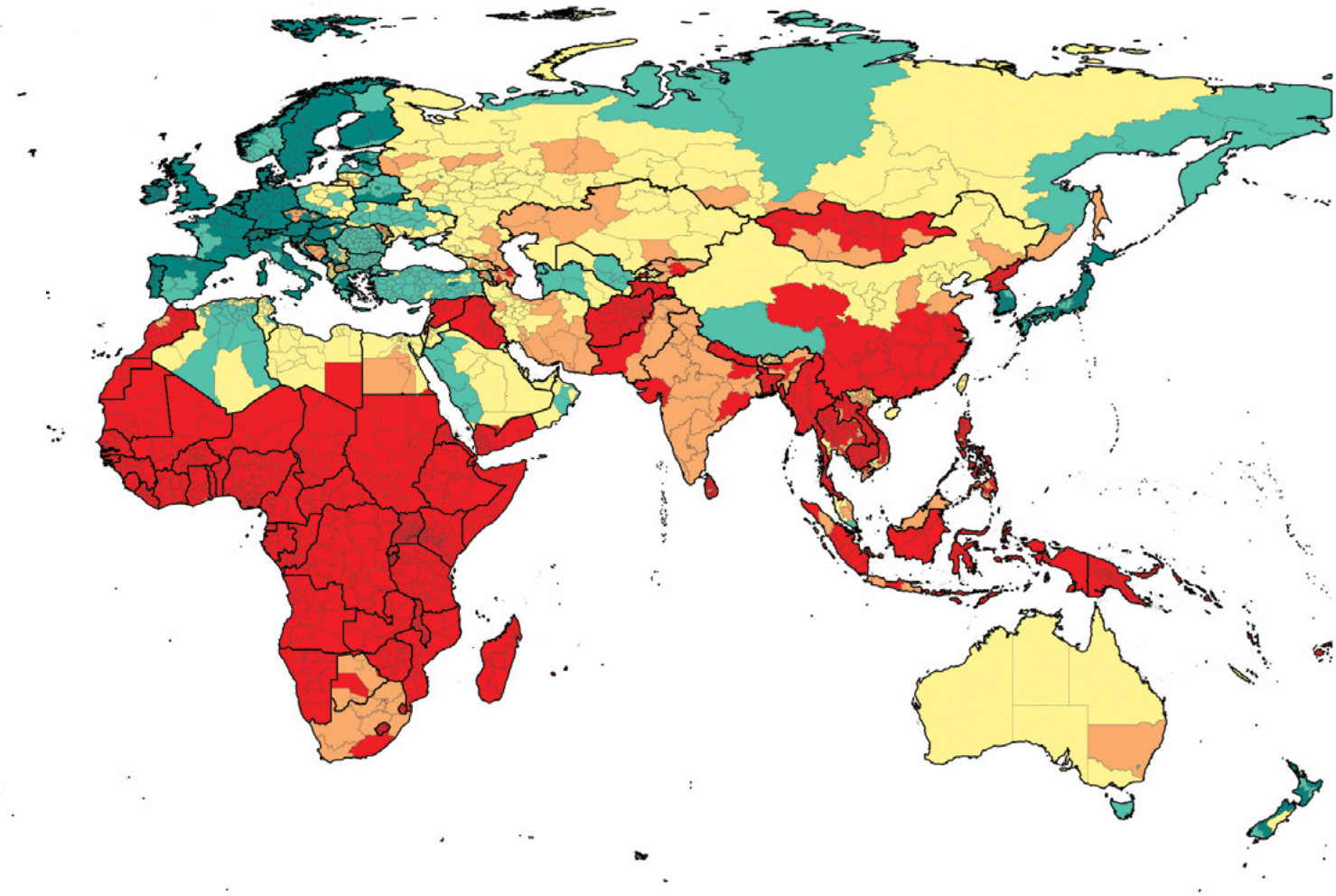
Source: IEP

The ETR focuses on four categories of threat that are directly related to drivers of conflict. These threats are classified by severity from *Very Low* to *Severe*. A country is defined as facing a severe threat if it exceeds one or more of the following thresholds:

- **Food Insecurity**: More than 65 per cent of the population could not afford food for their families in the past year.
- **Natural Disasters**: A higher than eight per cent chance of facing a natural disaster that negatively impacts more than five per cent of the population.
- **Demographic Pressure**: More than 70 per cent increase in population by 2050.
- **Water Risk**: More than 20 per cent of the population do not have access to clean drinking water.

The ETR is calculated at the sub-national administrative level of a country, according to its relative threat level on four domains. A sub-national score is calculated as the maximum severity it faces across all four threats. For more details, see the methodology section or the methodology at a glance in Box 1.2.

Figure 1.1 highlights the severity of ecological threats faced by 3,594 sub-national areas, with areas in red facing at least one severe threat. It shows that the most vulnerable countries are clustered in certain geographical regions: sub-Saharan Africa, Middle East and North Africa (MENA), and South Asia. These regions are also the least peaceful, as measured by the GPI. For a list of the 221 countries covered in the report please refer to Appendix B.



BOX 1.2

Methodology at a glance

The Ecological Threat Report (ETR) was developed to identify countries at the highest risk of ecological threats. The ETR focuses on the problems of resource scarcity and natural disasters and their impact on peacefulness. The ecological threats included in the ETR are water risk, food risk, population growth and natural disasters. The ETR facilitates analysis of the impacts of ecological threats on peacefulness and the role of societal resilience in determining the ability to adapt and mitigate such risks.

The ETR is a multi-indicator composite measure of risk, which is calculated in two steps. In the first step, all indicators are normalised on a one to five scale, with a higher score representing a higher threat level. This calculation is at the sub-national level. In the second step, the overall ETR score is calculated using the maximum of the individual ecological threats.

At the national level, a country's indicator score is the population weighted average of its sub-national areas. Thus, for a country to have a severe score for a given indicator, all sub-national areas in the country must be facing a severe threat level for that indicator.

A country's overall ETR score is the maximum score of any its four indicators. Thus, if a country has at least one indicator score of 'severe', its overall ETR score will be rated as severe.

Some countries may have a small number of ecological threats, but these threats may be severe. When combined with low resilience, these are the countries most at risk and are further discussed in the Severe Threats, Positive Peace and Hotspot sub-sections

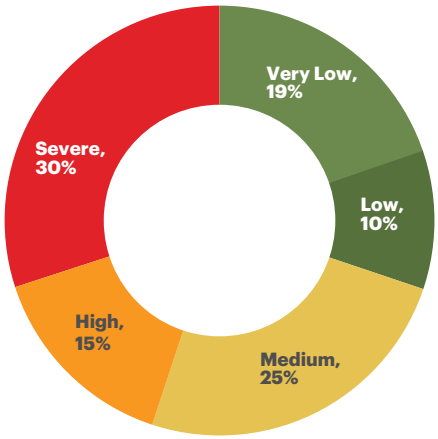
THREAT SEVERITY

Figure 1.2 displays the distribution of countries by the severity of the ecological threat they face. Of the 221 countries in the ETR, 30 per cent have at least one severe ecological threat. These countries are home to an estimated 1.8 billion people or 22 per cent of the global population. By 2050, this figure is projected to rise to 2.8 billion people, with the largest overall increases occurring in Nigeria, Democratic Republic of the Congo, Tanzania and Ethiopia. While not all of the population of these countries will suffer from the direct impact of adverse ecological events, the indirect impact will be felt widely. This is especially the case if the countries are facing conflict, civil unrest, or poor governance. Displacement of persons and competition for food and water resources may cause the impact of the original shock to transcend across national, and even continental boundaries.

FIGURE 1.2

Distribution of the ETR threats, percentage of countries, 2023

45 per cent of the countries in the ETR are facing at least one severe or high ecological threat.



Source: IEP Calculations

THREATS BY REGION

The level of ecological threat faced by countries is not uniform. There is considerable variation within regions. Europe and North America are the only two regions where no countries face a severe threat. Even in sub-Saharan Africa, the region with the highest overall average threat level, there are countries facing only a medium level of ecological threat. Figure 1.3 shows the overall average score for each region in the 2023 ETR. North America and Europe are the two regions with the lowest average score, whereas South America, South Asia and sub-Saharan Africa are the regions with the highest average score.

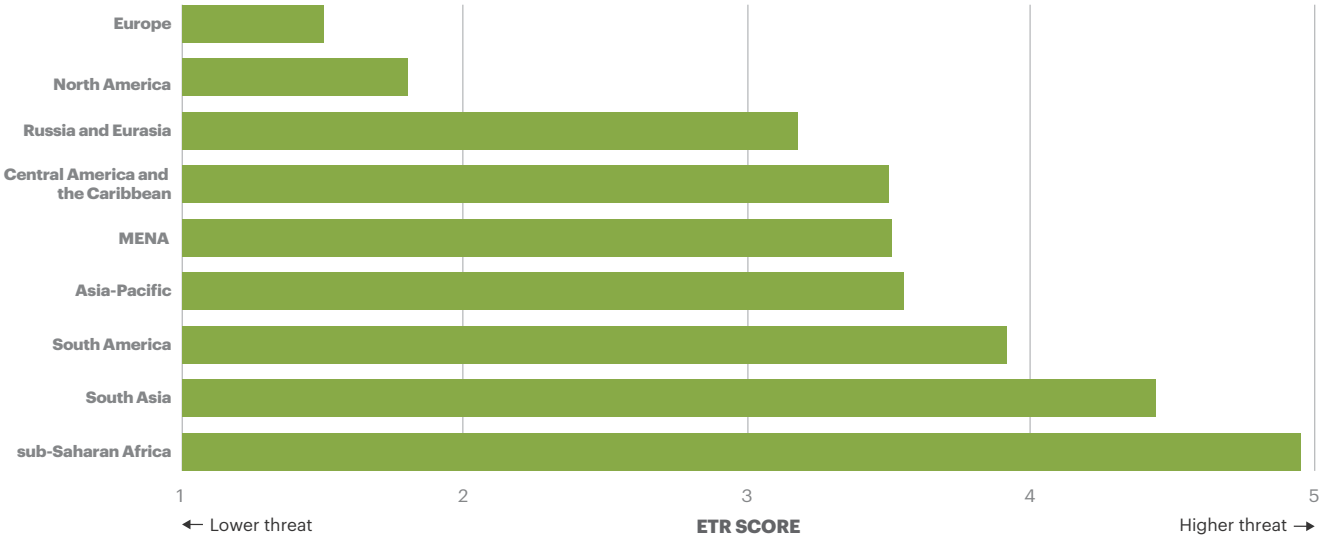
Sub-Saharan Africa has the worst ETR score, with 49 of the 52 countries and territories in the region facing at least one severe ecological threat. By 2050, sub-Saharan Africa's population is predicted to rise to 2.2 billion, an increase of over 60 per cent, which will increase pressure on existing food and water supplies. Sub-Saharan Africa also has the highest proportion of its population suffering from food insecurity. Most countries across sub-Saharan Africa are dependent on rain-fed agriculture, making the region particularly vulnerable to changes in climatic conditions, such as prolonged droughts and seasonal floods.[12] Agriculture is the mainstay of most economies in the region, accounting for just over 17 per cent of value-added GDP, higher than in any other region.[13]

South Asia recorded the second highest ETR score. The region has the highest natural disasters score, with Bhutan being the only country in South Asia where the threat of natural disasters was rated 'very low'. Natural disasters exacerbate other ecological threats, particularly resource scarcity. Moreover, rapid population growth and unplanned urbanisation coupled with environmental degradation and climate change have increased the region's exposure and risk to natural hazards, resulting in more frequent, intense, and increasingly costly disasters.

FIGURE 1.3

Average ETR score by region, 2023

Sub-Saharan African and South Asian countries have the highest average ETR score.



Source: IEP Calculations

ECOLOGICAL THREATS AND CONFLICT

TABLE 1.1

Correlation of ETR scores with GPI Domain Scores, 2023

There is a very strong correlation between food insecurity and water risk and peace.

ETR Indicator	Safety and Security	Ongoing Conflict	Militarisation
Food Insecurity	0.69	0.45	0.06
Water Stress	0.59	0.36	-0.01
Natural Disasters	0.39	0.23	0.03
Demographic Pressure	0.49	0.42	0.14

Source: IEP

There is a strong correlation between ecological threats and peacefulness. Table 1.1 displays the statistically significant correlations between the prevalence of ecological threats and the three GPI domains. The prevalence of all four ecological threats increases where countries are less peaceful in the *Safety and Security* and *Ongoing Conflict* domains. *Militarisation* is the only domain not strongly correlated to ecological threat. The strong relationship between peacefulness and ecological threats highlights that less peaceful countries have a higher prevalence of ecological threats, particularly food insecurity and water stress.

The strongest relationship is between the prevalence of food security and *Safety and Security*, with a correlation coefficient of 0.69. This is followed by the relationship between water risk and *Safety and Security*, with a correlation coefficient of 0.59. These relationships would be expected as food insecurity and water risk can be either an exacerbating factor or direct result of conflict, violence or political instability.

Increased ecological threats from a changing climate will have security implications at the micro and macro levels. When local communities experience ecological shocks, they can then lead to political instability when the country's levels of resilience are low. For example, when a record-breaking drought in Kenya's rift valley limited access to land and water in the region, pre-existing conflict and grievances amongst herders and farmers were amplified, with conflict in the region resulting in 200 deaths in 2021.[14] Similarly, in South Sudan, ongoing conflict and a multi-year drought drove unprecedented levels of food insecurity.[15] Security can also be affected when mitigating actions taken by one community negatively affects another. This has been seen in the hydroelectric dams and irrigation systems. Examples include dams in Türkiye, China and Ethiopia that restricted access to water in downstream countries.[16]

A consequence of natural disasters, water scarcity, food insecurity, and above-average temperature is that they cause migration and displacement. Individuals fleeing harm can add more pressure to areas that are not directly affected by the disaster. Migration can intensify competition over jobs, housing, and other resources.[17] The relationship between conflict, ecological threat, and climatic changes are explored in more detail in **Section 3** of this report.

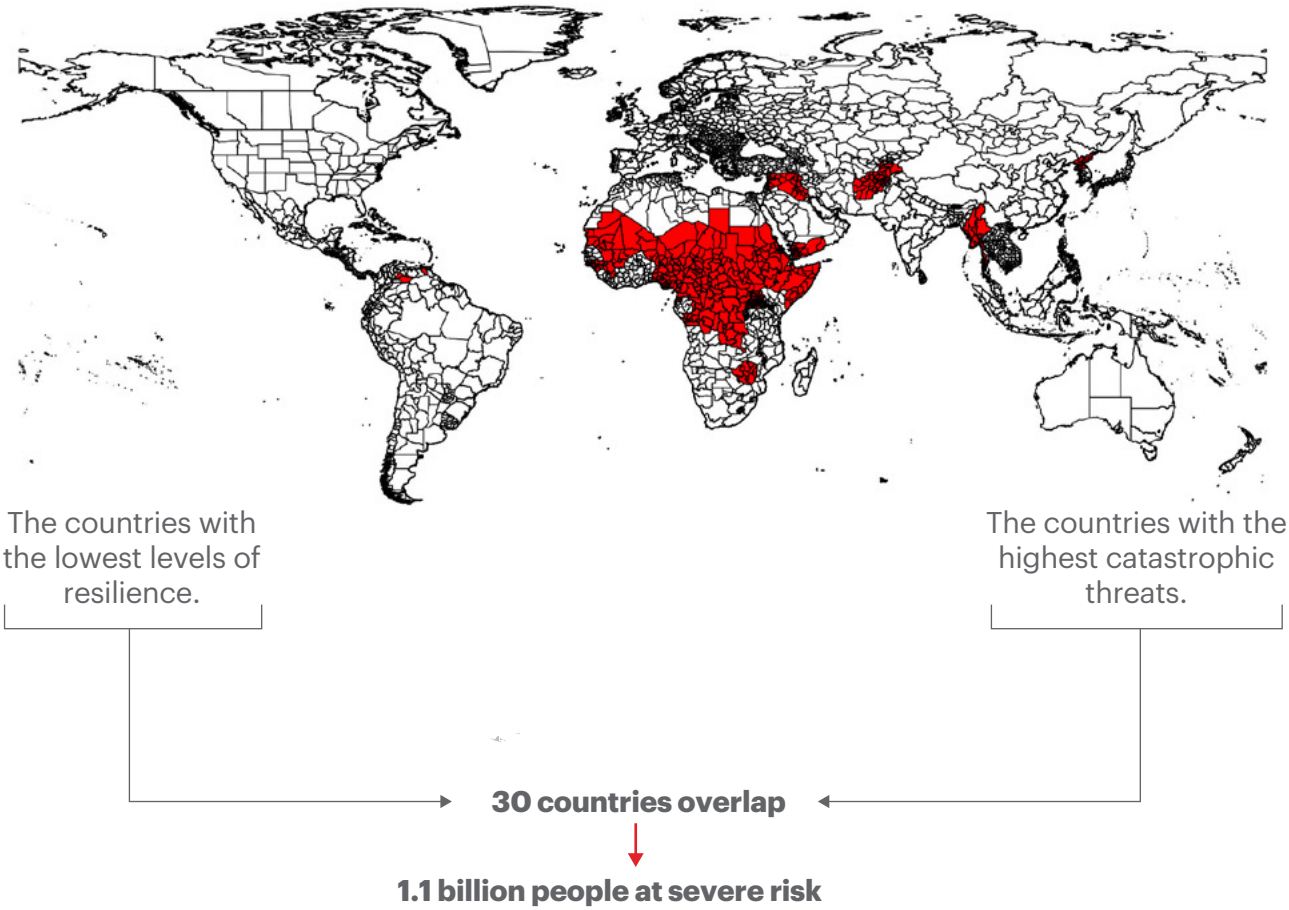
> South Asia recorded the second highest ETR score. The region has the highest natural disasters score, with Bhutan being the only country in South Asia where the threat of natural disasters was rated 'very low'.

Country Hotspots

FIGURE 1.4

Calculating countries at risk of ecological threats

IEP estimates there are 1.1 billion people living in countries where societal resilience is unlikely to be sufficient to withstand the impact of their ecological threats.



Source: IEP

Countries have different levels of capacity to respond to ecological threats due to the varying strength of their societal systems. This capacity to respond is captured in the Positive Peace Index (PPI) which measures resilience through the *attitudes, institutions and structures* of societies. These are the same factors that create capacity and adaptability.

Countries that rank higher in PPI have stronger institutions and coping mechanisms, which means they are better prepared to deal with ecological threats. Conversely, countries with low levels of Positive Peace lack resilience, meaning that even moderate shocks may lead to conflict or disorderly re-arrangements in the structure of the economy and political system.

Positive Peace is strongly correlated with higher levels of food security, water security and the ability to manage natural disasters. This is because countries with stronger socio-economic development are better organised, have more resources and higher social cohesion. They also have more effective disaster response mechanisms, and their governance systems are more transparent, responsive, and adaptable.

IEP's hotspot analysis compares the countries and areas facing at least one severe threat with the PPI. A hotspot country is defined as one that is ranked in the bottom 30 countries on the PPI, and also facing at least one severe ecological threat. The hotspot countries are shown in the map in Figure 1.4, and listed in detail in Box 1.3.

BOX 1.3

Hotspot Countries, 2023

The following countries are classified as 'hotspot' countries. This means they face at least one severe ecological threat and are ranked amongst the 30 countries with the worst levels of Positive Peace.

Burundi	Cameroon	Uganda	Nigeria
Democratic Republic of the Congo	Central African Republic	Zimbabwe	North Korea
Guinea	Chad	Haiti	Syria
Niger	Equatorial Guinea	Iraq	Tajikistan
Republic of the Congo	Eritrea	Libya	Venezuela
Somalia	Ethiopia	Mali	Yemen
South Sudan	Guinea-Bissau	Mauritania	
Afghanistan	Sudan	Myanmar	

KEY FINDINGS

2.2 billion

By 2050, sub-Saharan Africa's population is predicted to rise to 2.2 billion, an increase of over 60 per cent, which will dramatically increase pressure on existing food and water supplies.

2.8 billion

IEP estimates that by 2050, 2.8 billion people will reside in countries facing severe ecological threats, compared to 1.8 billion in 2023. Most of the increase will be in sub-Saharan Africa.

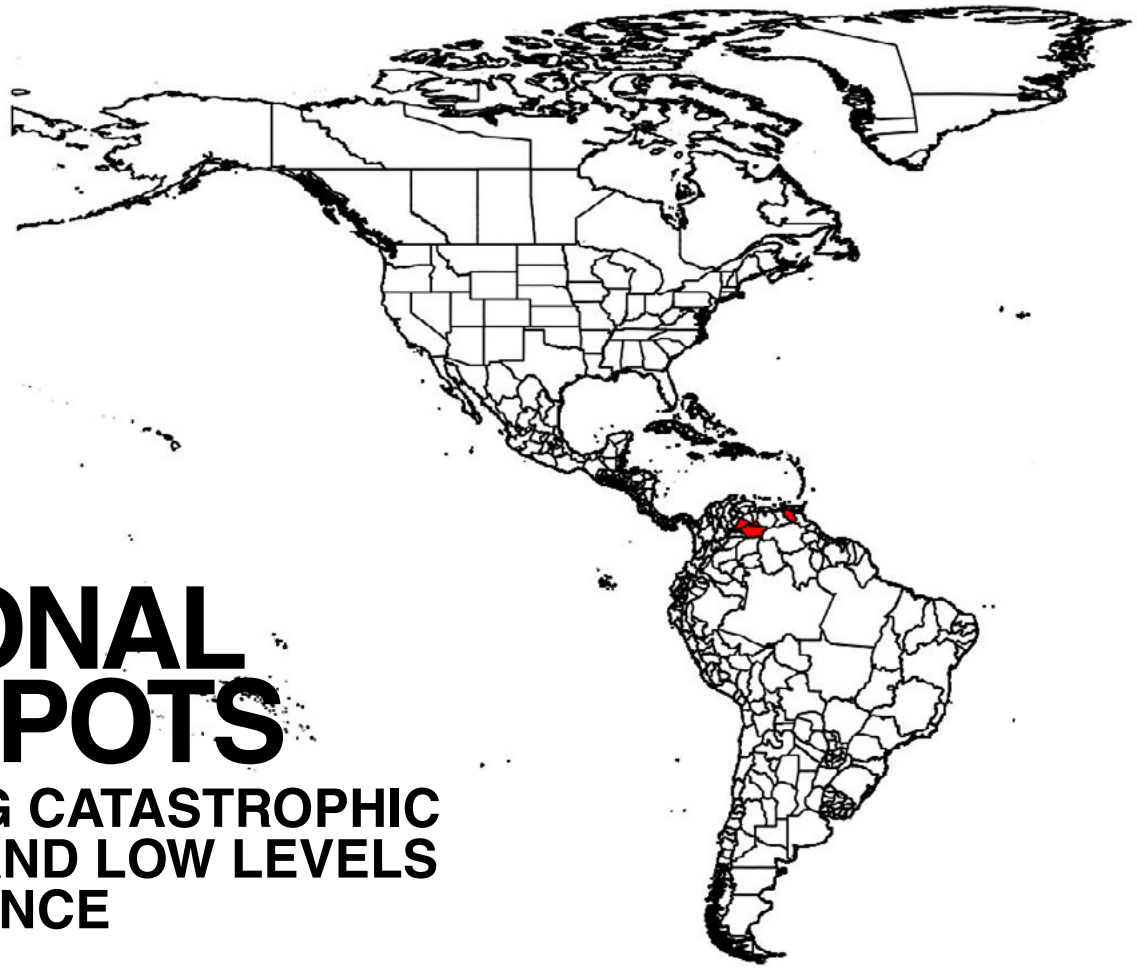
45%

Forty-five per cent of the countries covered in the ETR face either high or severe threat level.

FIGURE 1.5

ETR hotspots, 2023

30 countries have subnational areas that are identified as combining a severe level of ecological threat with extremely low societal resilience as measured by the PPI.



Source: IEP Calculations

Ecological hotspots tend to be clustered in certain geographical areas. Figure 1.6 displays the number of countries identified as a hotspot by region. At 19 countries, sub-Saharan Africa has the highest number of countries of any region, followed by MENA with five countries. This clustering is significant because ecological and humanitarian crises often spill over across international borders. This spillover effect occurs through population flows, cross-border conflict, and logistic links between countries.

The relationship between peacefulness, food insecurity, water scarcity and population growth is complex. If multiple ecological threats occur simultaneously, they can converge and mutually reinforce, causing a multiplier effect. For example, a country may be exposed to water stress and dedicate resources to addressing this threat. However, the combination of water stress and a rapidly growing population may exacerbate food insecurity, causing other effects, such as higher inflation, unplanned migration or increases in crime. Multiple stressors are also more likely to lead to negative societal outcomes such as political instability, social unrest and violent conflict. In turn, this may cause more damage to physical infrastructure and further deplete already scarce resources, thus creating further food insecurity and water stress. The interplay between ecological threats and socio-economic dynamics may lead a country into a vicious cycle of progressively greater adversity.

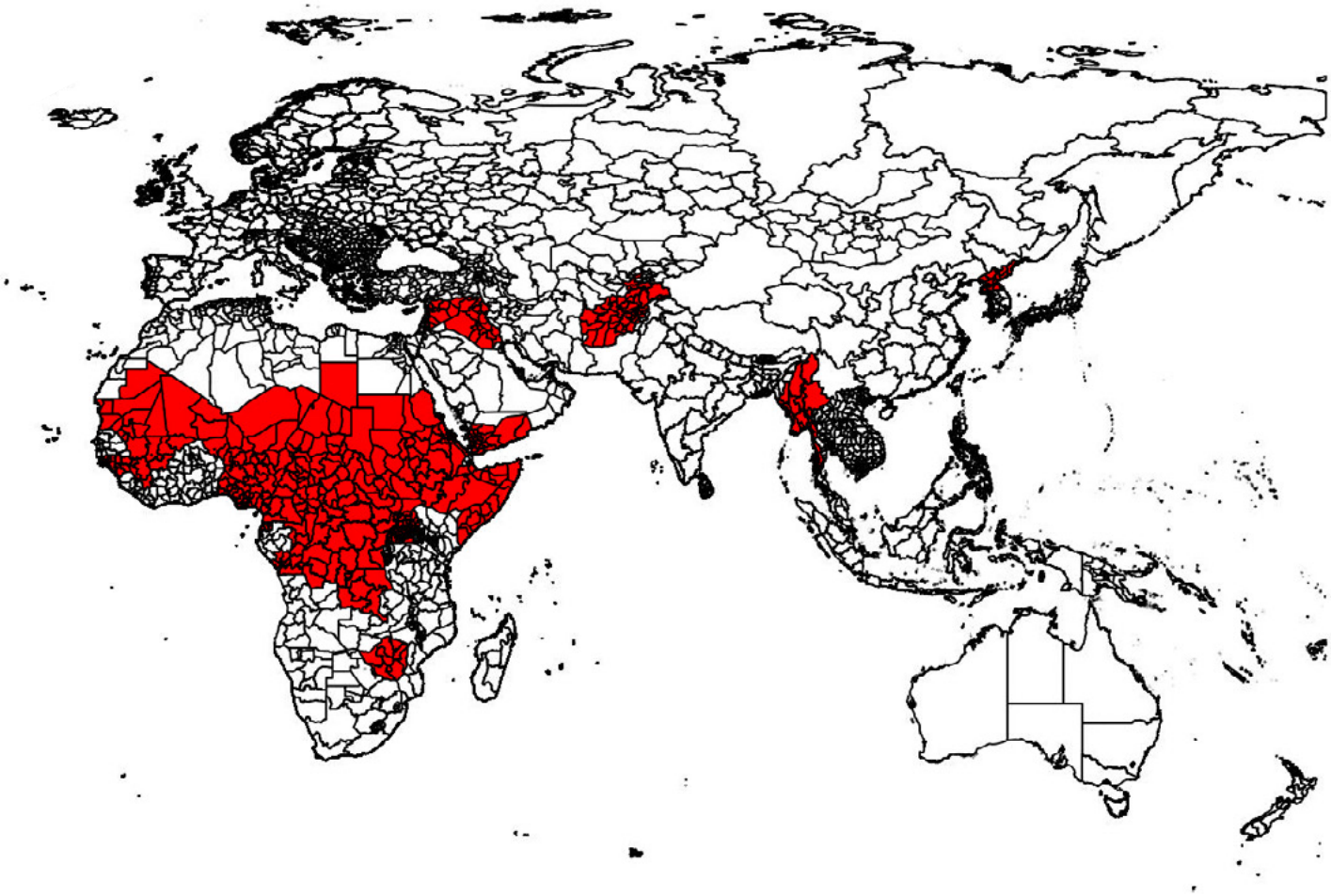
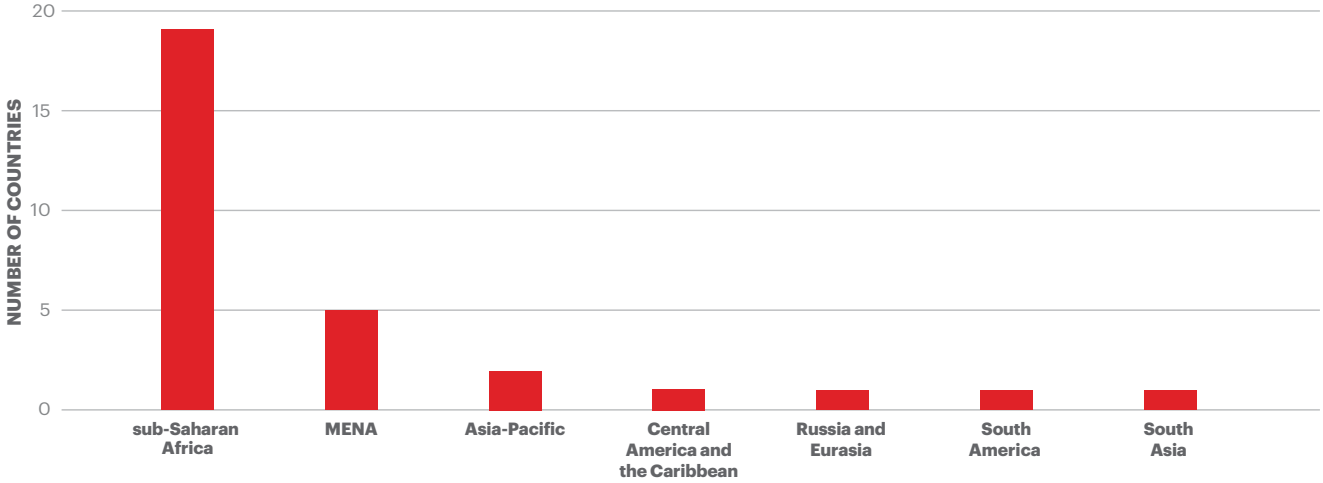


FIGURE 1.6

Number of hotspot countries by region, 2023

Sub-Saharan Africa has the highest number of countries identified as hotspots.



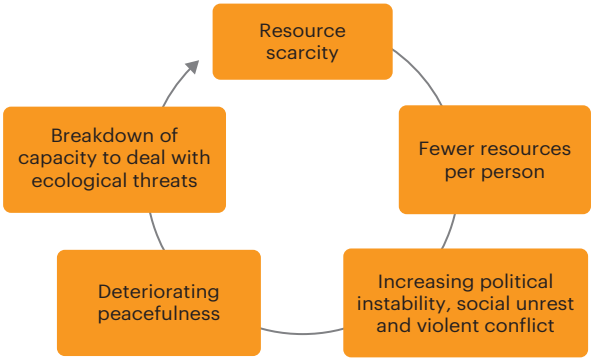
Source: IEP Calculations

Figure 1.7 displays the vicious cycle for changes in resource scarcity and peacefulness.

FIGURE 1.7

The vicious cycle of increasing resource scarcity

Increased stress on resources can lead to deteriorations in peacefulness in a vicious cycle.



Source: IEP

There are four sub-national areas that face severe threats in all domains and are all located in two sub-Saharan African countries, Ethiopia and Niger. These are the areas that need the most urgent attention, with both suffering from high levels of conflict (refer to Table 1.2). Almost 69 million people living in these areas are exposed to a severe level of water scarcity, food insecurity, demographic pressure, and natural disaster threat.

HOTSPOTS: SHOCKS AND RESILIENCE

Shocks can be classified as sudden substantial inputs into a system. If large enough, they will overwhelm the internal structures of the system, causing them to change or even collapse. The resulting system from the shock may be a better system or worse depending on the resilience of the system and the strength of the shock. The COVID-19 pandemic, for instance, was a shock to society because a new input – contagion – affected how individuals, groups, governments, and businesses operated. This affected the economic, political and health systems of countries.

Some shocks can be internally generated and are the result of a societal system's own dynamics. These are known as *endogenous* shocks. Examples of endogenous shocks are political revolutions, civil unrest or economic crises. *Exogenous* shocks have causes and triggers that lie outside the social system, such as some types of natural disasters, invasions or pandemics. Shocks are often amplified by *stressors* – factors not necessarily related to the shock itself, but which reduce the ability of a social system to cope and recover.

Resilience is a social system's ability to minimise the effect of a shock and recover in its aftermath. When faced with a shock, systems will first attempt to limit the direct impact on their sub-systems. This is known as *coping capacity* and has been defined by the UN as "the ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters."[18]

High levels of resilience mean national systems have superior coping capacity in terms of physical infrastructure, regulatory frameworks, economic strength and diversification, emergency preparedness and response systems. In addition, they also have superior capacity to rebuild their socio-economic systems in the aftermath of the shocks.

For small to moderate shocks, the social system will limit the negative repercussions on the population and the economy, while the recovery will lead to a return to pre-shock levels of wellbeing. However, if the shock is severe enough, a system may reconfigure its internal structure. This may mean that the resulting structure is less stable and contains less capacity. This can mean that the next shock will have a more destabilising impact on the system, thereby causing a vicious cycle where a weakened societal system creates a higher likelihood of future shocks. The concept of resilience is illustrated in Figure 1.8.

In contrast, a highly resilient system struck by a shock can reconfigure to become a more resilient system and more capable of dealing with future shocks. The 2011 Great East Japan Earthquake (GEJE) and tsunami set off a chain of direct and indirect impacts felt at the societal and economic level in Japan but also at the international level, affecting global supply chains. While the GEJE was undoubtedly ruinous, losses were reduced due to Japan's disaster risk management strategies, such as earthquake warning systems.[19] Since 2011, Japan has reconfigured its internal structure to strengthen its resilience to low probability, high impact threats by creating resilience policies that emphasize the holistic and continuous approach to resilience that should be engaged with even during times of stability.[20]

Positive Peace is an effective predictor of socio-economic resilience for countries and regions, as discussed in previous IEP research. This is because societies that operate with high levels of Positive Peace tend to:

TABLE 1.2

Subnational areas facing severe ecological threat in all domains

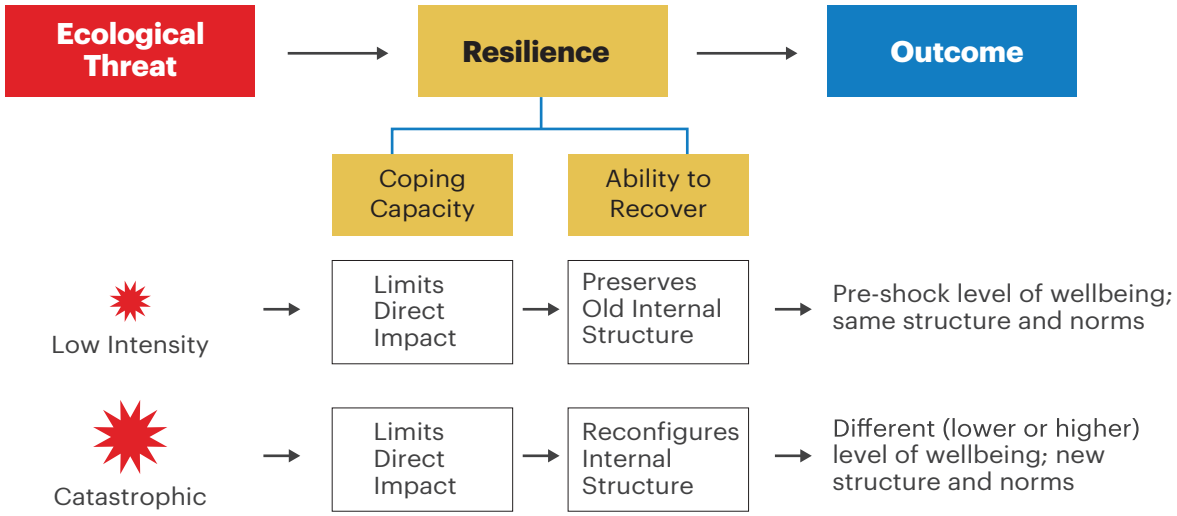
Country	Region	Sub-national Areas	Location	Description	2023 Population
Ethiopia	sub-Saharan Africa	Oromia	Central	Largest region in Ethiopia by population and area.	48,258,195
Niger	sub-Saharan Africa	Maradi	South	Most populous region in Niger.	7,106,950
Niger	sub-Saharan Africa	Zinder	South	Second most populous region in Niger.	6,673,394
Ethiopia	sub-Saharan Africa	Somali	East	Second largest region in Ethiopia by area.	6,532,213

Source: IEP

FIGURE 1.8

Shocks and resilience

Resilience is the ability to protect the population by limiting the primary impacts of a shock and restoring the system, sometimes to higher levels of wellbeing.



Source: IEP

- be more effective in protecting lives and livelihoods from the impact of natural disasters;
- recover more rapidly from economic crises;
- adjust more easily and quickly to technological, business and social disruption; and
- promote the peaceful resolution of grievances and disputes between citizens and groups.

These shocks occur with broadly the same frequency across countries with all levels of peace. However, countries with very low levels of Positive Peace have a fatality rate seven times higher than those with very high levels of Positive Peace. This happens because the Pillars of Positive Peace work in systemic ways to enhance a country's coping capacity. *Sound Business Environment* guarantees enough resources and infrastructure assets to treat people affected by the disaster and repair physical damage. *Equitable Distribution of Resources* means that all individuals, groups and demographics have access to protective infrastructure, equipment and services. A *Well-Functioning Government* allocates resources efficiently and transparently to groups or areas where they are most needed, and so on.

A socio-economic system comprises multiple sub-systems. These can be geographic, such as households, cities or areas, or notional such as a nation's education system or its judiciary.

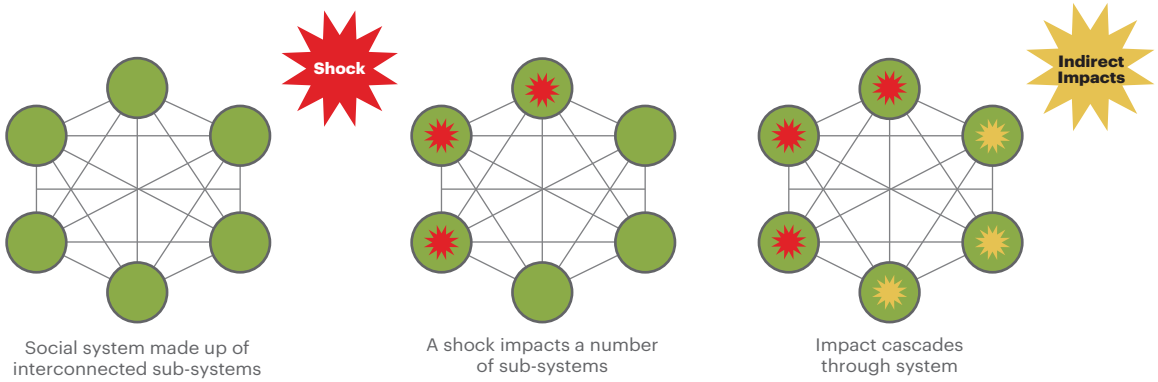
When it first manifests, a shock may impact only some of a nation's sub-systems directly. In time, however, the interconnectivity between sub-systems re-transmits the ramifications of the shock throughout the nation. This pattern is illustrated in Figure 1.9.

The Japanese tsunami of 2011 offers one example of a shock transmission through sub-systems. In its direct impact, the disaster caused death and destruction in the north-eastern coast of the country. Subsequently, damaged nuclear power plants in the

FIGURE 1.9

The direct and indirect impact of system shocks

A shock impacts system components in different ways. After the initial impact, the shock cascades through the system.



Source: IEP

region contaminated crops and water supplies with radiation, affecting health and food production sub-systems in surrounding areas.[22]

Another example is the 2010 earthquake in Haiti, which caused severe loss of life and widespread destruction. After the immediate impact, the country experienced a breakdown of its law-and-order infrastructure contributing to civil unrest and looting.[23]

Thus, the more severe threats a country faces, coupled with weak resilience, the more fragile a country will likely be.

ECOLOGICAL THREAT AND THE GREEN TRANSITION

Efforts to keep global temperatures below a 1.5-degree Celsius increase require a massive shift from fossil fuels to zero carbon emissions energy sources. This shift is essential for global emission goals to be reached but could be challenging for countries that are heavily dependent on fossil fuel revenues. Presently, 40 countries rely heavily on these revenues. The United Nations Development Programme believes these nations could face losses of over 60 per cent of their current GDP between 2023-2040 under a net-zero 2050 scenario, a loss of rents that is equivalent to over 120 per cent of current GDP.[24] This potential loss, coupled with limited opportunities for economic diversification and ecological threats, might lead to significant social and economic disruptions.

Figure 1.10 shows the relationship between the ETR, high oil dependence, and GDP per capita, which is a proxy for low capacity to transition away from oil dependency. Most countries that are dependent on fossil fuel rents also have low GDP per capita, and the majority of these countries face high or severe levels of ecological threat.

Fossil fuels account for more than 40 per cent of GDP in Iraq and Timor-Leste. They both have low GDP per capita and face at least one high to severe-level ecological threat, which will make shifting away from this dependency very difficult.

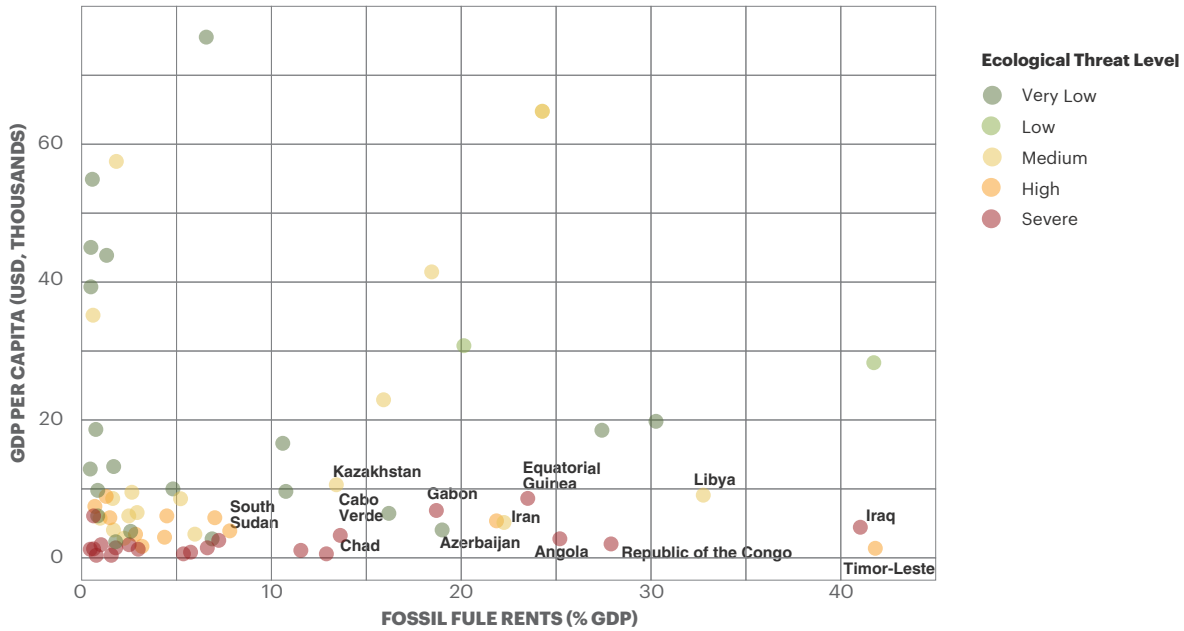
This transition trap occurs across the globe, with some countries in the Americas, Africa, MENA, South Asia, and Asia-Pacific among the most dependent and ecologically threatened. Some, like South Sudan and Libya, are already unstable. Others, like Angola, Iran, Azerbaijan, and Chad have histories of tension and conflict. Economic downturns could spark more issues. All of these states face at least one high level ecological threat, indicating that they're already feeling environmental pressures. As climate change worsens, these threats will only grow, and their ability to cope might be limited.

By contrast, countries have the capacity to become energy superpowers either through the direct production and transmission of zero emissions electricity or via extraction of critical minerals and resources required to build the green energy transition infrastructure. This economic boom, in theory, presents an opportunity for countries that possess increasingly vital minerals including nickel, cobalt, lithium and copper, the value of which is projected to soar in the following decades. The presence of particularly rare minerals or availability of reserves in a small number of states has the potential to set off new scrambles for resources and associated geopolitical competition. The Democratic Republic of Congo, for example, produces 70 per cent of the world's cobalt, a critical mineral for current electric battery storage technology that is considered key to the electrification of vehicles.[25] As the fifth least peaceful country in the 2023 Global Peace Index, and a country that has faced *ongoing conflict* over existing resources of critical minerals, there are significant questions as to whether the DRC can avoid future resource curses.

FIGURE 1.10

Fossil fuel rents (% of GDP) vs GDP per capita and ETR level

Almost every country with low GDP per capita and high fossil fuel rents as a % of GDP faces at least a medium level of ecological threat.



Source: World Bank; IEP Calculations

2 Ecological Threats

KEY FINDINGS

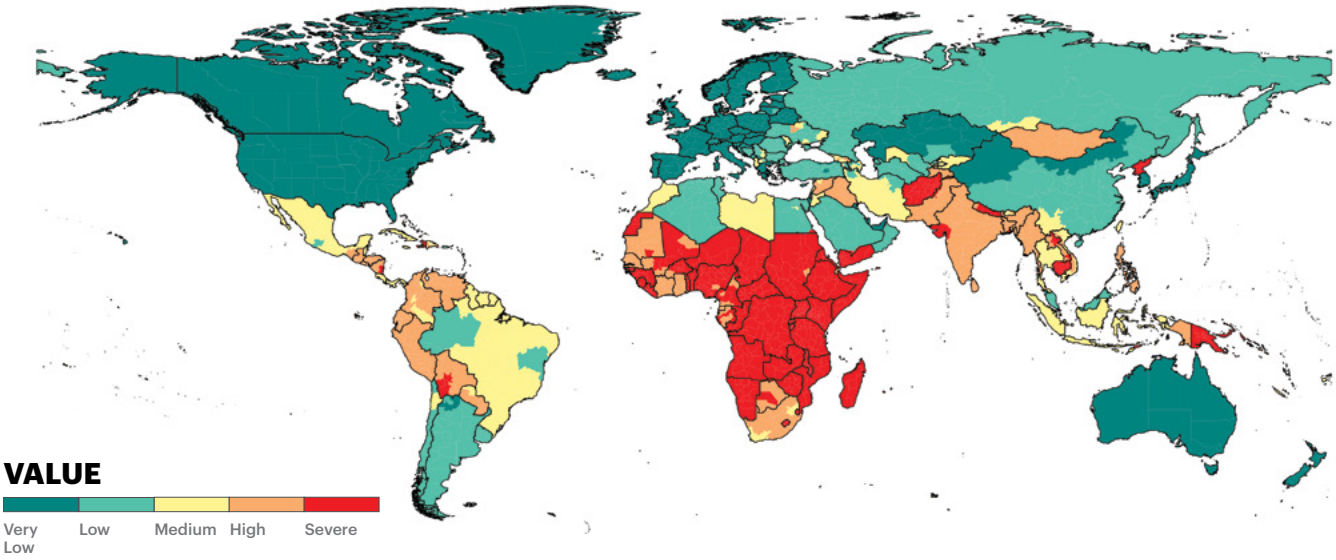
- Food Insecurity remains a major issue globally. The Global Food Price Index is currently 33 per cent higher than in 2016, after successive increases of 35 per cent following COVID, and then a further 18 per cent following the Russian invasion of Ukraine.
- 42 countries face severe food insecurity. Surveys from these countries show that more than 65 per cent of the population have been unable to afford food for their family at some point in the past year.
- More than one billion people in sub-Saharan Africa live with high or severe levels of food insecurity. This number is expected to increase to almost two billion by 2050.
- 35 of the 52 countries and territories in sub-Saharan Africa suffer from extreme food insecurity. 81 per cent of people suffering from extreme food insecurity globally live in sub-Saharan Africa.
- In sub-Saharan Africa 62 per cent of the population live in areas with severe levels of food insecurity.
- Food insecurity is more likely to occur in areas with small monoculture farms that depend on the sale of cash crops.
- Water risk is a key driver of conflict, with water-related violent incidents exhibiting a threefold increase on average since 2000.
- Globally, there are 46 countries where the level of water risk is severe, and a further 31 countries where the level of water risk is high. This is where more than 20 per cent of the population does not have access to clean drinking water.
- Two billion people live in areas without access to safe drinking water.
- The number of countries using more than 80 per cent of their water supply for irrigation, livestock, industry, and domestic purposes has risen from 17 in 2019 to 25 in 2023. Most of these countries are located in sub-Saharan Africa and MENA.
- By 2040, MENA is projected to have the same water stress as sub-Saharan Africa.
- Water scarcity is expected to worsen in numerous countries in the Russia and Eurasia region by 2040. This could have a significant impact on agriculture in the region.
- Over 1.8 billion people live in subnational areas at severe risk from natural disasters, there is a strong chance that over five per cent of the population will be impacted by a devastating natural hazard.
- When countries lack resilience, natural hazards, such as earthquakes or floods, are more likely to become natural disasters. There are 44 countries with both a high risk of natural disasters, and low resilience. These countries are home to more than four billion people.

- Thirty-five per cent of total funding from the UN Central Emergency Response Fund (CERF) was dedicated to aiding in the aftermath of natural disasters in 2022, compared to just 17 per cent a decade ago.
- CERF pledged almost US$200 million to aid 21 countries following a natural disaster in the first seven months of 2023, surpassing the yearly total for eight of the past ten years.
- Demographic pressure poses a significant ecological threat in many regions of the world. Over 40 per cent of the subnational areas in the 2023 ETR are expected to record population growth of at least 20 per cent between now and 2050.
- The bulk of this population increase is likely to occur in countries with low levels of peacefulness. Nearly half the population of the world is projected to be living in countries with very low levels of peacefulness, as measured by the GPI, by 2050.
- The 40 least peaceful countries will have an additional 1.3 billion people by 2050, at which point they will account for just under half of the total world population.
- Most countries in the world are transitioning to stable or contractionary population structures, as the number of young people relative to the number of old people continues to decline.
- Sub-Saharan Africa is still expected to increase its population by just under 62 per cent by 2050, from 1.3 billion to 2.2 billion people.
- Total youth population growth in sub-Saharan Africa is so high that the number of people aged 15 or under in the region is projected to be higher than the entire population of Europe by 2050.

Food Insecurity

FIGURE 2.1

Subnational food insecurity domain scores, 2023



Source: UNDESA

This section analyses global and local patterns of food insecurity and their relationship to conflict and environmental shocks. Figure 2.1 shows the distribution of food insecurity at the subnational level across the world.

The ETR identifies 42 countries as facing severe food insecurity. Surveys from these countries show that more than 65 per cent of the population have been unable to afford food for their family at some point in the past year.[1] When large proportions of a country's population lack food security, economic development and societal cohesion are adversely affected.[2]

Sudden shocks not only disrupt the accessibility of food, they can also create knock-on effects that result in heightened political instability, increase of violence, more civil unrest, large levels of forced migration and a higher likelihood of civil conflict. Food shortages and water scarcity are interrelated, with a lack of water often leading to food shortages.

To be food secure, people must have access to sufficient nutritional food that meets their basic preferences, dietary needs, and enough food to achieve an active and healthy life. Within the context of the ETR, food security comprises two elements: availability and accessibility.

- Food availability requires that a sufficient amount of food that is of appropriate quality be supplied, whether through domestic production, imports or aid.
- Food accessibility requires that legal, political, economic and social arrangements provide people with the ability to acquire food.
- If either of these elements is lacking, food security is compromised.

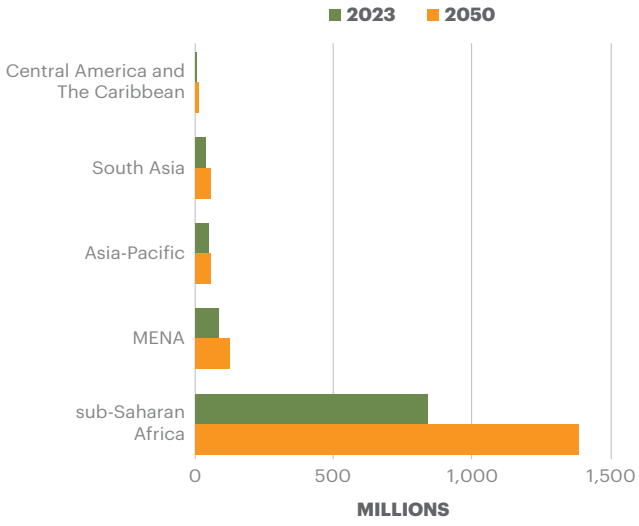
FOOD INSECURITY BY REGION

There is significant variation in food insecurity by region, as shown in Figure 2.2. In sub-Saharan Africa, IEP estimates that 62 per cent of the population live in areas with severe levels of food insecurity.

FIGURE 2.2

Projected population living in extreme food insecurity by region, 2023 and 2050

By 2050, 1.4 billion people are projected to be living in severe food insecure areas of sub-Saharan Africa.



Source: WPP; IEP Calculations

The MENA region has the second highest number of people living with extreme food insecurity, equal to 15 per cent of the total population of the region or 87 million people. Most of these people live in either Sudan or Yemen; both countries are affected by conflict. The population in the affected areas in MENA is projected to grow by over 128 million by 2050.

South Asia is the region with the third largest number of people living in extreme food insecurity. Almost nine per cent of the region's population live in subnational areas with extreme food insecurity, or 175 million people in total. The population of these areas is expected to reach 212 million by 2050. Most of those affected live in western India or Afghanistan.

FOOD INSECURITY AND GLOBAL STABILITY

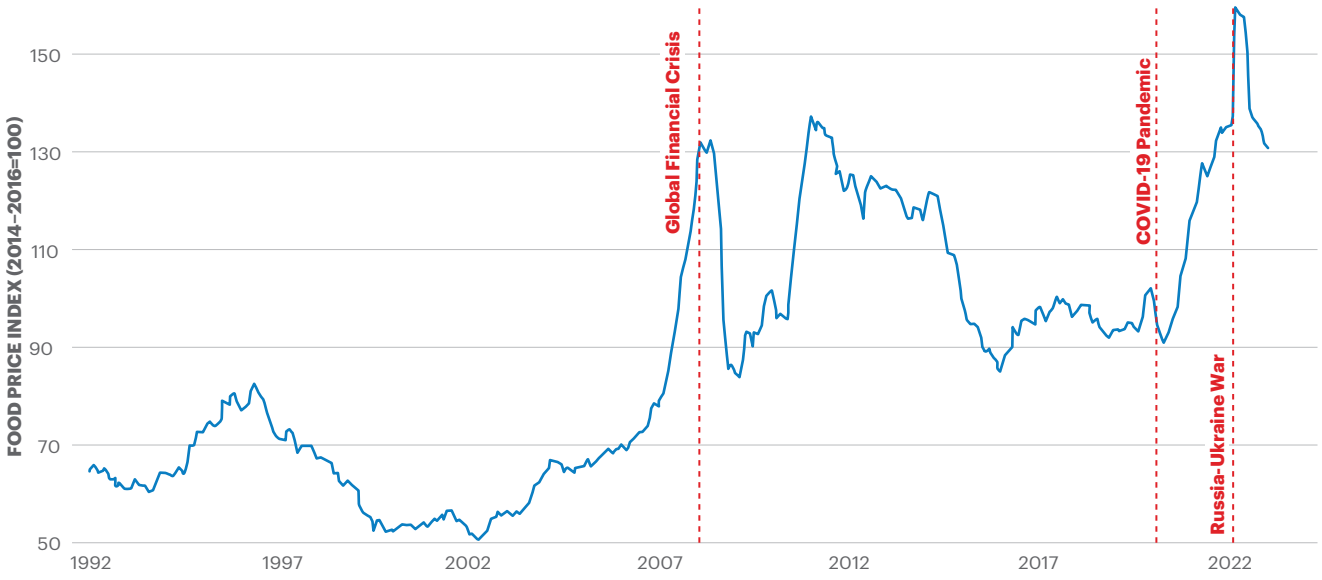
Many countries rely on food imports for food security, which means they depend heavily on international trade routes and supply chains. As such, major international events can impact the food security of many nations. Figure 2.3 shows the trend of the FAO Food Price Index for the period between 1992 and 2023, along with major global events over the period.

After the 2007 Global Financial Crisis, food prices rose by up to 40 per cent in the following 12 months. In the two years following the WHO's declaration of the COVID-19 pandemic, global food prices rose by 35 per cent. In the month after the Russian invasion of Ukraine, the Food Price Index rose by another 18 per cent, and as of July 2023 it remains 25 per cent higher than pre-pandemic levels.[3]

FIGURE 2.3

Monthly Food Price Indices (2014–2016=100), 1992–2023

Food Price Indices increase in times of international crisis.



Source: FAO; IEP Calculations

FOCUS AREA: FOOD INSECURITY AND LOCAL LIVELIHOODS

Food insecurity is caused by many factors including variability of seasonal rains, poverty, lack of adequate infrastructure to harvest water, poor governance, lack of security and ongoing conflict. Food insecurity is rare in highly economically developed countries with effective institutions.

Most of the sub-Saharan African region experiences high levels of food insecurity, with seasonal and changing ecological conditions exacerbated by ongoing conflict. Food insecurity can also contribute to ongoing conflict, acting as both a cause and effect of violence in the region.

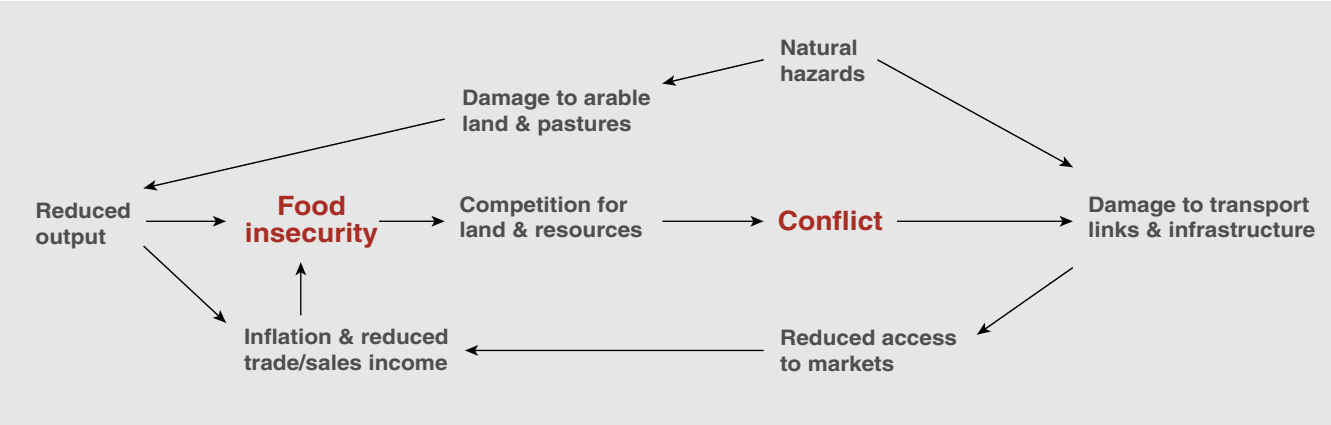
The relationship between conflict and food insecurity is complex, with potential pathways shaped by a range of factors in a dynamic system. To help break down this complexity, Figure 2.4 depicts some of the main relationships, including the impact of environmental shocks like extreme weather and natural hazards. Food insecurity can be a potential impact of conflict when damage to agricultural land and transport links reduce output and distribution. On the other hand, it can also be a contributing cause of conflict. Food insecurity associated with extreme weather events can exacerbate conflict by increasing the willingness of local populations to fight for control of land and resources.[4] Whether and how these effects materialise depends on the effectiveness of the governing institutions, strength of the infrastructure and a range of other factors. A more detailed breakdown of the relationship between food insecurity and conflict is presented in **Section 3** of this report.

Cameroon is a compelling case study for food insecurity, as it exhibits all the major climatic conditions on the African continent and contains varying levels of both ecological threat and ongoing conflict at a subnational level. The consequences of these threats for resident populations depend upon the socioeconomic characteristics of the local areas. Patterns of food insecurity in Cameroon demonstrate the types of local economies that are most affected by the interaction of ecological threat and conflict in sub-Saharan Africa.

FIGURE 2.4

Relationship between food insecurity and conflict

Food insecurity can be a potential factor or contributing cause of conflict.

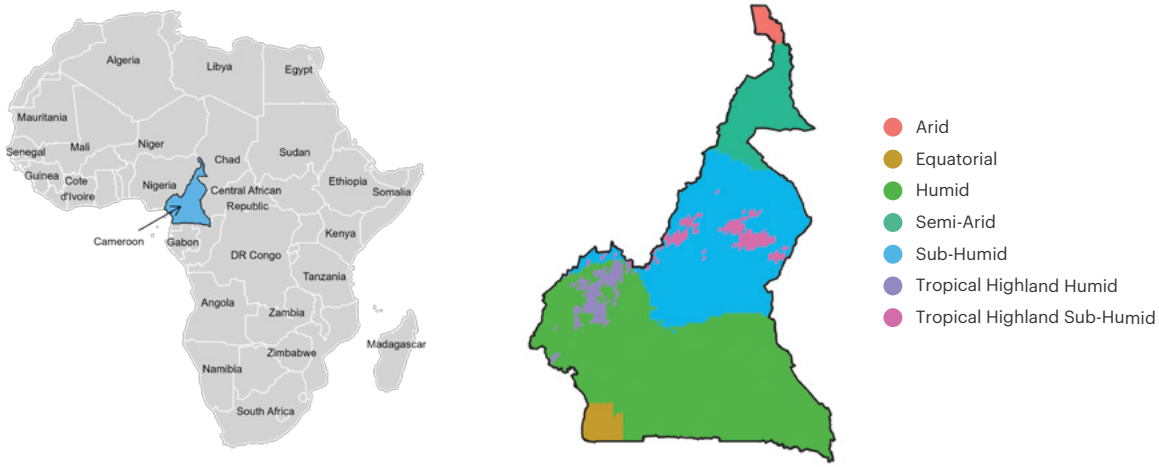


Source: IEP

FIGURE 2.5

Location and ecological zones of Cameroon

The territory of Cameroon includes all the major climatic zones of the African continent.



Source: FAO

As shown in Figure 2.5, Cameroon straddles West and Central Africa. Cameroon encompasses all the key climatic zones found in Africa, featuring a mix of savannahs, mountains, forests, deserts, and transitional regions. This diverse landscape allows for different farming practices across the country. Being close to cities and international markets also affects the occupations of the local population. These areas, with their unique climate and economy, are 'livelihood zones' where people have similar ways to earn and face similar food insecurity risks.[5]

Most livelihood zones in Cameroon are based on agropastoral farming systems, where the main sources of household income include the sale of both livestock and crops. Cattle farming is most common in the semi-arid plains and high plateaus, while small animal stocks, such as poultry, sheep and goats are more common in forested areas.[6] The main crop staples vary based on local geographies and access to water, but maize is the most common grain, an important export, and the primary source of animal feed.

Figure 2.6 maps maize-growing livelihood zones against the administrative areas with lower or higher levels of food insecurity. Most of the areas with lower levels of food insecurity are also zones where maize is locally produced. This is particularly true in the humid areas of the south where there are two annual growing seasons for grains, so grains are less susceptible to variations in rainfall patterns. In these parts of Cameroon, most livelihood zones with low maize production experience higher levels of food insecurity.

In the central and northern parts of the country, there are several regions that experience high levels of food insecurity despite local production of maize and alternative staples such as sorghum. Even though staple food production is relatively high in these areas, household livelihoods are directly or indirectly affected by ongoing conflict. The far northern region, bordering Nigeria, experiences attacks by the Nigerian-based Islamist militant group Boko Haram and its splinter organisation Islamic State West Africa (ISWA). Areas in the country's west are affected by conflicts involving Anglophone Ambazonian separatist groups in the aftermath of long-term territorial disputes with Nigeria. These conflicts are not driven by food insecurity, but rather they contribute to it by damaging agricultural land and disrupting food harvesting and distribution.

The central and eastern regions bordering the Central African Republic have relatively lower levels of conflict, but they are indirectly affected because they have received a high number of displaced persons from conflicts across the border. The increase in population contributes to food insecurity by putting pressure on food prices and compounding the effect of late rains on the single growing season in this part of the country.[7]

The livelihood zones most affected by food insecurity are more reliant on cross-border trade and cash crops such as coffee and cocoa as a source of income. Figure 2.7 maps cross-border trading zones, and livelihood zones that rely on the sale of cash crops against food insecurity levels.

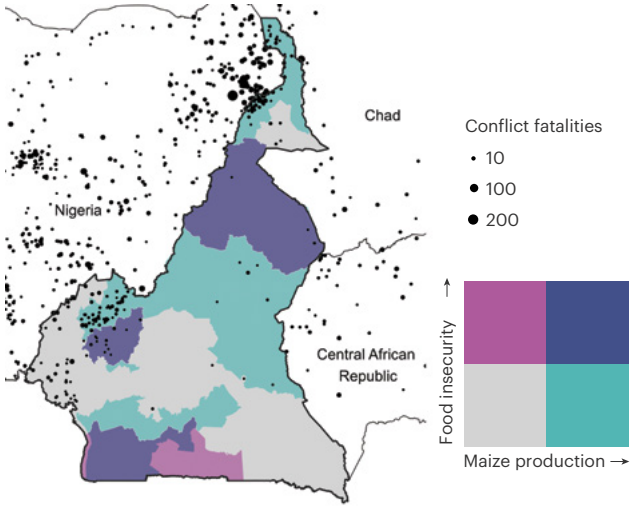
Areas dependent on cash crops are particularly vulnerable to food insecurity. In Cameroon, 95 per cent of cocoa farms are smallholdings with limited adaptive technology and low crop diversity, and in cocoa-producing areas 90 per cent of households are dependent upon the crop as a source of income. This means that extreme weather events, pests and disease have significant impacts on household livelihoods.

The conflict-affected border zones in the north and west of Cameroon are also the parts of the country where households are most reliant on cross-border trade. The presence of conflict affects trade by reducing the availability of agricultural products. It also means that trading routes become more dangerous and reducing mass transport and roads are less likely to be maintained. The resulting inflationary pressures on staples and reduced income from cash crops decreases household purchasing power, contributing to food insecurity.[9] Conflict-related economic

FIGURE 2.6

Maize production, food insecurity and conflict in Cameroon, 2022

The areas of Cameroon least affected by food insecurity are maize-growing livelihood zones.

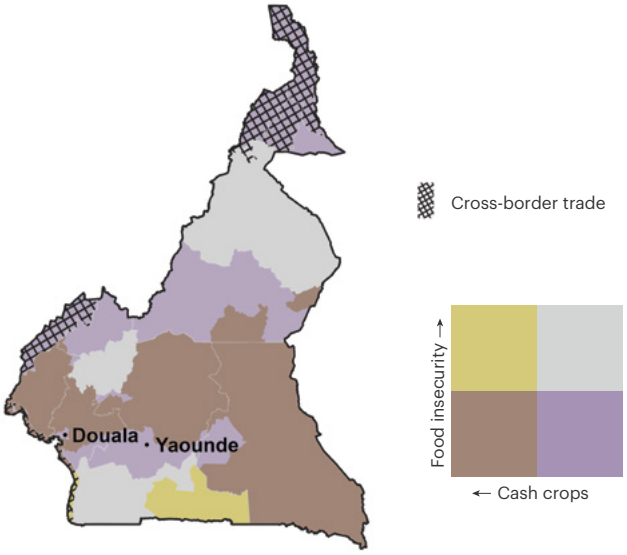


Source: FEWS NET; ACLED; IEP

FIGURE 2.7

Food insecurity, trade, and cash crops in Cameroon

The areas of Cameroon most affected by food insecurity are more reliant on cross-border trade and cash crops.



Source: FEWS NET; IEP

instability also affects food insecurity in the urban livelihood zones of Yaoundé, the capital, and Douala, the main port.

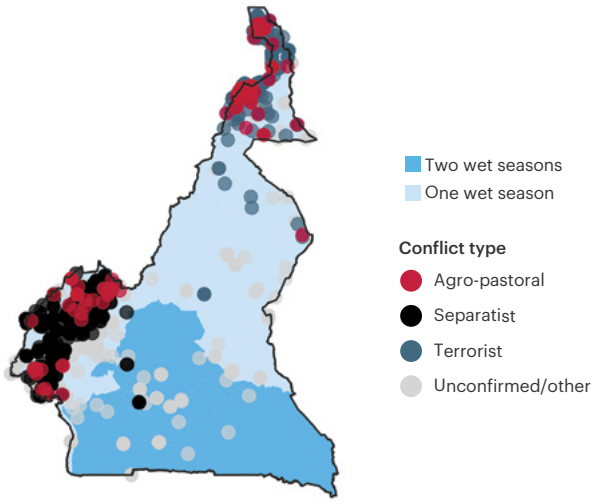
Figure 2.8 shows that in the southern region, which experiences two wet seasons, there are notable low levels of conflict and violent events involving farmer or pastoralist groups. The concentration of agro-pastoral conflict in zones with one wet season can be related to the longer periods between rainfall. When the rains fail, droughts become more severe, leading to conflict over resources. High population growth in Cameroon is another contributing factor, with the most stressed regions being the conflict-affected regions of the north. The level of cultivation is also lower in the forested south and there are fewer large livestock like cattle that can damage cropland, reducing the likelihood of tensions between farmers and pastoralists.[10]

Almost all agro-pastoral conflict occurs in areas that are also affected by terrorist or separatist violence. The presence of other types of violence, including terrorism, can intensify conflict between farmers and herders. Violence limits access to land and water sources, forcing pastoralists to encroach on more distant farming communities.[11] Outside of the conflict-affected regions of the north and west, there is little agro-pastoral conflict in areas that experience either one or two wet seasons.

FIGURE 2.8

Rainfall zones and conflict events by type, 2018–2022

Outside of the conflict-affected regions of the north and west, there are similar levels of conflict in areas which experience either one or two wet seasons.

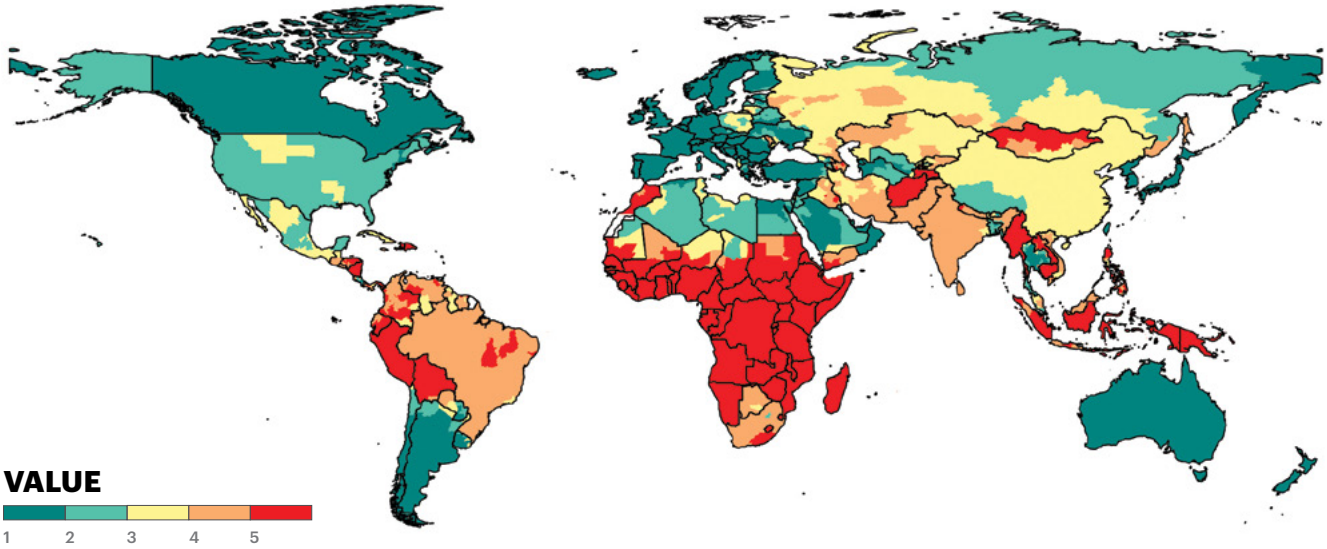


Source: FEWS NET; ACLED; IEP

Water Risk

FIGURE 2.9

Subnational water risk domain scores, 2023



Source: World Resources Institute

Water risk is one of the most significant ecological threats the world is currently facing. Two billion people globally live in areas that lack access to safe drinking water while 3.6 billion lack access to safe sanitation.[12] Water stress impedes economic development and food production, which further compromises the health and well-being of the population. It can also lead to social tension, conflict and displacement. In the ETR, water risk is measured by looking at the percentage of the population of the subnational areas that has access to clean drinking water.

Figure 2.9 shows the distribution of water risk globally at the subnational level. There are 46 countries where the level of water risk is severe, and a further 31 countries where the level of water risk is high. Water risk has the greatest impact in sub-Saharan Africa, South Asia, and Latin America.

While most sub-Saharan countries face extreme water stress, some also contend with internal water disparities. For example, in South Africa, eight of the nine provinces suffer from high or severe water risk, as described in Box 2.1. However, the Gauteng province, home to both the nation's capital, Pretoria and its largest city, Johannesburg, has low levels of water risk.

BOX 2.1

Cape Town and 'Day Zero'[13]

In 2019, Cape Town faced the prospect of its residents having no access to water. In order to conserve freshwater for critical services, the taps were to be switched off on 'Day Zero', as the six city dams reached a storage level of 13.5 per cent. Thankfully, rains arrived just prior to the shutdown.

However, it remains a reminder of Cape Town's water insecurity. Cape Town's predicament rose out of a prolonged drought. Additionally, the city's water infrastructure had not been maintained and was in poor condition. Without efficient policies, the predicament is likely to occur again.

The threat posed by water risk is expected to keep rising over the next quarter of a century. According to estimates by the World Resources Institute, 25 countries currently utilise over 80 per cent of their renewable water supply to cater irrigation, livestock, industry and domestic needs, compared to 17 countries just three years earlier.[14]

Most of these countries are in sub-Saharan Africa or the MENA region. Figure 2.10 shows that these two regions will have the highest number of subnational areas facing severe water stress by 2040. Europe is the region with the next highest level of projected exposure.

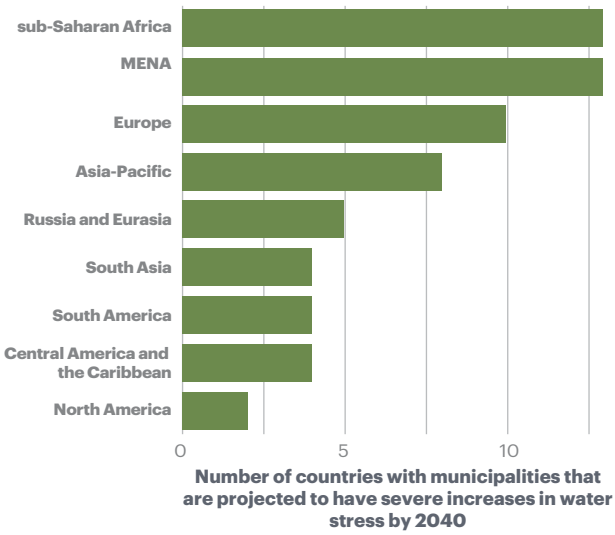
In Europe, approximately 75 per cent of total water extraction originates from rivers and reservoirs, while the remaining 25 per cent is derived from groundwater sources. [15] The region is experiencing a growing prevalence of droughts and water scarcity, affecting roughly 20 per cent of its land area and impacting 30 per cent of its population annually.[16] Southern and south-western European countries, such as Spain, Portugal and Italy, face particularly concerning trends. Here, water stress is driven by the demands of agriculture, public water supply and tourism, with pronounced peaks during the summer season. These challenges are exacerbated by excessive groundwater extraction, as intensified droughts force deeper water sourcing, especially in agriculture, industry and urban settings, to counter reduced rainfall and rising temperatures.

Investments in water-use efficiency are anticipated to stabilise water usage in wealthier countries in Europe and North America. However, the water resources entwined within global trade, especially originating from lower-middle-income countries to their high-income counterparts, stand as a substantial factor in the increasing water stress experienced by low and lower-middle-income nations.[17]

FIGURE 2.10

Number of countries with municipalities projected to be severely water stressed by 2040

By 2040, MENA is projected to have the same level of water stress as sub-Saharan Africa.



Source: WRI; IEP Calculations

Water stress is caused by both physical and economic factors. Physical scarcity arises when ecological conditions limit water availability, posing challenges in meeting demands for agriculture, household use and industry. This shortage often stems from insufficient rainfall, seasonal variability in rainfall or occurrences of floods and droughts. In contrast, economic scarcity emerges due to insufficient water management and infrastructure, despite potentially available water resources. This category is influenced by factors such as excessive groundwater extraction, outdated distribution systems and population growth surpassing available water management capacity.[18]

FIGURE 2.11

Water stress ETR domain for Russia and Eurasia

Eight out of twelve countries in the region currently face high or very high level of water risk.

Source: IEP

FOCUS AREA: WATER STRESS IN RUSSIA AND EURASIA

Azerbaijan, Moldova and Tajikistan face the highest levels of water risk in the region. Every subnational area in Tajikistan is currently facing severe water risk. Almost half of the population does not have access to a safely managed water supply, the lowest level of any country in Central Asia.[23]

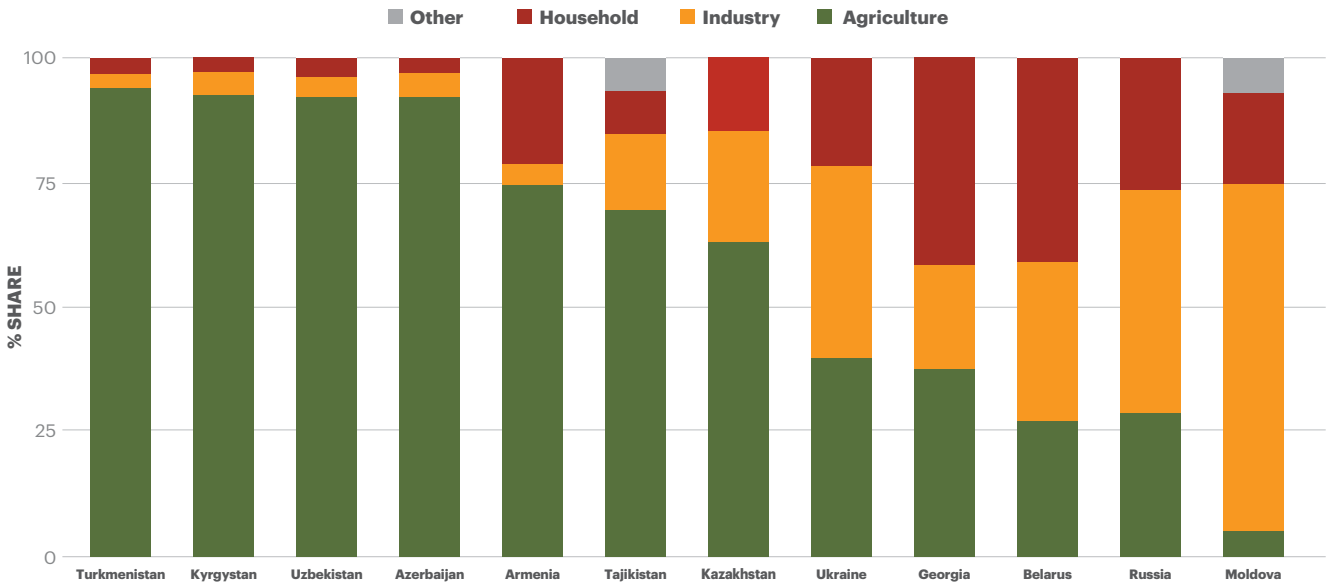
Tajikistan has a history of internal instability. It fell into civil war between 1992—1995, shortly after gaining independence. Initially triggered by regional groups from the Garm and Gorno-Badakhshan areas rebelling against the newly-formed government under President Rahmon Nabiyev, the conflict led to an estimated 50,000 to 100,000 casualties and displaced between 600,000 and one million individuals, both internally and into Afghanistan.[24]

Water scarcity is projected to increase in Tajikistan and its neighbouring countries in central Asia: the Kyrgyz Republic, Uzbekistan, and Kazakhstan. These countries heavily rely on agriculture, which is a significant contributor to their GDP. For instance, agriculture accounted for 12 per cent of Kyrgyzstan's GDP in 2022, five per cent in Kazakhstan, 24 per cent in Uzbekistan, and 22 per cent in Tajikistan.[25] As shown in Figure 2.12, approximately 90 per cent of water consumption in these countries is allocated for agricultural purposes.

FIGURE 2.12

Water consumption by sector, Russia and Eurasia Region, 2019

Over 90% of water consumption in Turkmenistan, Azerbaijan, Uzbekistan and the Kyrgyz Republic is related to agriculture.



Source: World Bank; IEP Calculations

The connection between water, energy and agriculture in the region is a major concern. This involves managing water, setting up agreements and working together to share water fairly. A clear example of these problems is the Aral Sea. It used to be the fourth-largest lake in the world, but since the 1960s, it has been drying up and becoming saltier. This happened mainly because water that should have gone to the Aral Sea was diverted for farming in Kazakhstan, Uzbekistan and Turkmenistan instead.[26] The surge in water intensive cotton production has further heightened water demand. As a result, the Aral sea shrunk by 65 per cent between 1960 and 2022.[27]

Access to water in the region is distributed along the banks of the two main rivers, the Amu Darya and the Syr Darya. Originating in the mountainous regions of Kyrgyzstan and Tajikistan, these rivers travel through Kazakhstan, Turkmenistan and Uzbekistan before reaching the Aral Sea. In Kyrgyzstan and Tajikistan, substantial water reserves are stored in mountain glaciers. In contrast, Kazakhstan, Turkmenistan, and Uzbekistan possess vast oil and gas deposits.[28] There are several rivers in Turkmenistan, but most flow in from neighbouring countries. In Kazakhstan, surface water resources are characterised by notable disparities, marked by significant seasonal fluctuations.[29]

Within the region, upstream nations Kyrgyzstan and Tajikistan prioritise water utilisation for hydropower generation through their hydropower plants. In contrast, downstream countries Kazakhstan, Turkmenistan, and Uzbekistan primarily allocate water resources for agricultural endeavours, encompassing food and cotton production.[30] The downstream nations are seeking more water to sustain their expanding agricultural sectors and growing populations, whereas the upstream countries aim to exert greater control over their resources. They aspire to harness more water for both electricity generation and agriculture.[31]

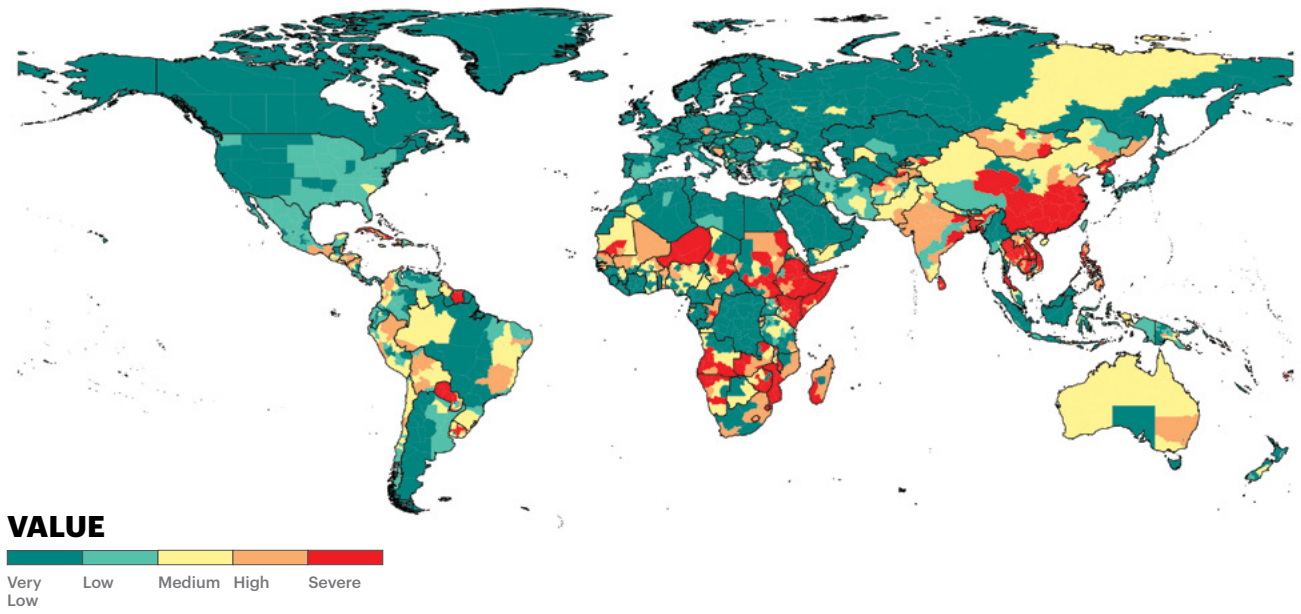
This dynamic and the pressure on water resources greatly increases the likelihood of water-related disputes, especially in the Ferghana region of Central Asia, where Tajikistan, Kyrgyzstan, and Uzbekistan share a common border alongside shared water bodies.[32] This complexity is further compounded by the shared management of approximately 40 water channels by Kyrgyzstan and Tajikistan. In addition, Tajikistan predominantly relies on irrigation, with over 90 per cent of its agricultural land being irrigated rather than rainfed.[33]

An example of these tensions occurred in 2021 when a deadly border conflict between Kyrgyzstan and Tajikistan erupted due to a water dispute centred around control of a canal and pumping site along the Isfara River among local residents. This conflict resulted in at least 31 fatalities, numerous injuries, and the evacuation of 10,000 individuals. Subsequently, in September 2022, another dispute escalated over roads, land and water resources, resulting in a death toll of 94 people and more than 100 injured.[35] In the past decade alone there have been 150 disputes along the shared Kyrgyzstani-Tajikistani border, leading to casualties on both sides.[36] A World Bank report released in 2021 estimated that water availability and crop productivity would generate climate migration hotspots in the region by 2050.[37]

Natural Disasters

FIGURE 2.13

Natural disasters domain scores at the subnational level, 2023 ETR



Source: IEP Calculations

Natural hazards are defined as extreme natural events that lead to more than ten people being killed or more than 100 people being strongly affected. There are many kinds of natural hazards such as floods, storms, cyclones, earthquakes, and epidemics, and these events are not necessarily mutually exclusive. A severe storm or cyclone may in turn result in flooding, and so on. When a natural hazard has a very strong negative impact on a society, it becomes a natural disaster.

BOX 2.2

Natural hazards and natural disasters

Natural hazards are defined as environmental events that have the potential to impact societies, for example, floods, earthquakes and wildfires.

A natural disaster is the negative impact following the occurrence of a natural hazard, especially if a society is low in resilience. For example, a natural disaster may occur after a natural hazard such as a severe storm if the community impacted has no resources or capability to recover from the physical, environmental and economic damage caused by the storm. If a natural hazard affects more than five per cent of the population it is considered a natural disaster in the ETR.

The risk of natural disaster may be high even if an area has not had a recent experience of that kind of event. For example, areas in flood plains or situated along geological fault lines may be at high risks from floods or earthquakes, even if it has been many years since a major event, and the risk of an event may even increase over time. Therefore, the natural disasters indicator in the ETR uses a probabilistic model to determine the risk of a natural disaster occurring. This model calculates the likelihood of a natural hazard occurring that would severely impact more than five per cent of the population in a subnational region. If the chance of such an event is higher than the maximum threshold, then the risk is deemed 'severe'. Figure 2.14 shows the distribution of natural disaster risk by subnational area around the world.

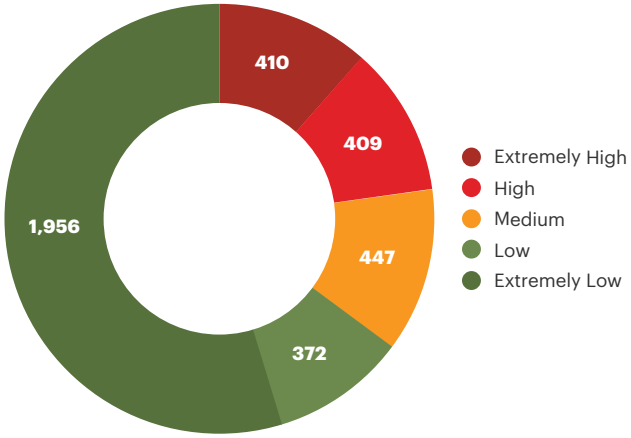
Clusters of subnational areas in East Africa, Southern Africa, and Southeast Asia are at severe risk of natural disasters. In contrast, across most of Europe, the risk of natural disasters falls into the very low category, primarily due to their coping capacity and societal resilience.

Figure 2.14 shows the distribution of scores on the Natural Disasters domain. Over 1.8 billion people live in subnational regions that have severe risk of natural disasters, recording the maximum score of five on the domain. On average, the risk of natural disasters is highest in South Asian and Asia-Pacific countries. European countries are at the least risk of natural disasters, with all subnational areas in the region recording a less than 1.4 per cent chance of a natural disaster occurring in a single year.

FIGURE 2.14

Distribution of subnational scores on the natural disaster domain

Eleven per cent of subnational areas globally face extremely high risk from natural disaster.



Source: IEP Calculations

KEY FINDINGS

> 65%

42 countries are facing extreme food insecurity. Surveys from these countries show that more than 65 per cent of the population have been unable to afford food for their family at some point in the past year.

Globally, there are 46 countries where the level of water risk is severe, and a further 31 countries where the level of water risk is high. This is where more than 20 per cent of the population does not have access to clean drinking water.

> 80%

The number of countries using more than 80 per cent of their renewable water supply for irrigation, livestock, industry, and domestic purposes has risen from 17 in 2019 to 25 in 2023.

DISASTERS AND RESILIENCE

In July 2023, UN Secretary-General Antonio Guterres cautioned that the era of global boiling had commenced. He highlighted that rising temperatures had already caused significant damage and urged leaders to take action to prevent further increases in the number of catastrophic disasters.[38] A disaster is a serious disruption of a society or system due to hazardous events interacting with exposure, vulnerability, societal resilience and capacity. Disasters result in environment, societal, and economic losses and impacts which may surpass the community's coping capacity requiring external assistance.[39] Most often, disasters materialise following a significant natural hazard such as a storm, drought, flood or earthquake. However, disasters occur only when a lack of resilience allows systems to be overwhelmed following a major natural hazard. Figure 2.15 illustrates the country disaster loop following natural hazards.

An example of this loop is seen in the aftermath of the 2010 earthquake in Haiti, which led to widespread devastation. The event triggered a downward spiral leading to social chaos and the breakdown of law and order. In contrast, Japan managed the aftermath of the 2011 tsunami and nuclear plant meltdown adeptly, containing the damage, addressing destruction and orchestrating an effective economic recovery. This divergence in immediate impact and subsequent consequences can be attributed to the substantial difference in resilience levels between the two nations. Haiti, ranked 146th on the Positive Peace Index, exhibited markedly low resilience, while Japan was among the top 20 Positive Peace countries globally. This exemplifies the role of Positive Peace as a measure of resilience, shielding populations from disaster's worst effects and facilitating post-disaster socio-economic restoration.

Figure 2.16 shows the relationship between the Positive Peace Index, a measure of resilience and a country's susceptibility to natural disasters. While most countries, irrespective of their resilience level, face a low risk of natural hazards, 44 countries exhibit both high disaster risk and low resilience. This means that they are unlikely to be able to cope following an extreme event, creating the risk of a serious disaster. These countries are home to over four billion people. The full list of these countries is given in Appendix C.

FIGURE 2.15
The country disaster loop

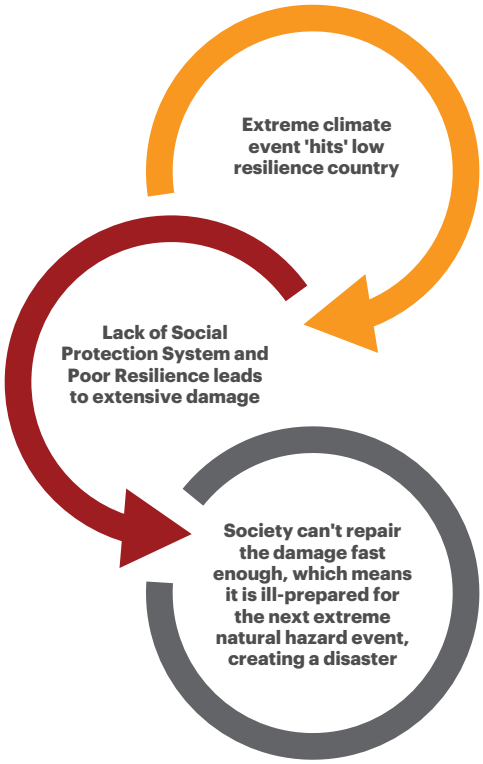
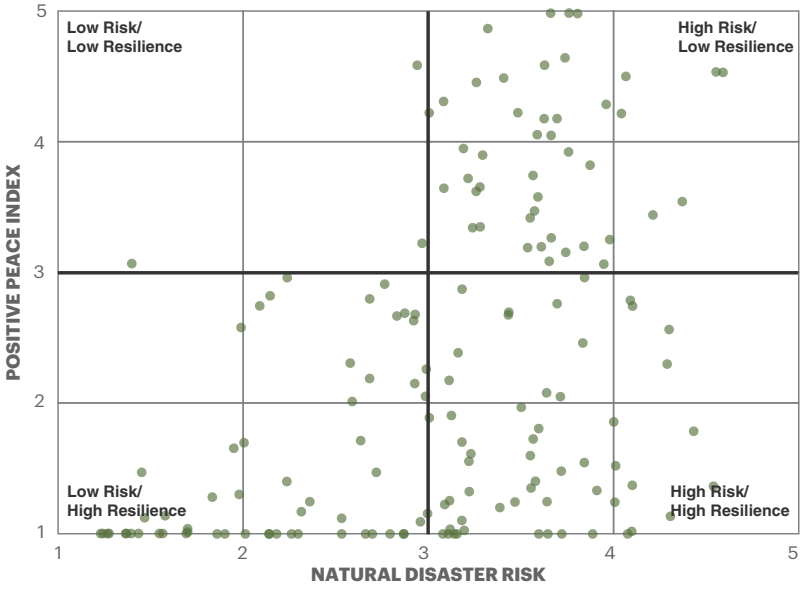


FIGURE 2.16
Positive Peace Index score vs natural disaster score

Of the 221 countries in the ETR, 44 have both low levels of resilience and a high risk of natural disasters.



Source: IEP Calculations

FOCUS AREA: DISASTER RELIEF FUNDING

The rising impact of natural disasters can be seen by looking at the distribution of emergency relief from the UN Central Emergency Respond Fund (CERF). CERF funding can go towards relief from conflict and displacement issues, health emergencies, natural hazards and various other types of disaster.

Figure 2.17 shows the distribution of funding by emergency type since 2006. The percentage of CERF fundings over the last three years pledged for assistance following a natural disaster is at the highest level since 2006, when the fund was established. It has increased from 17 per cent of total funding in 2013 to 35 per cent in 2022. Even during the height of the COVID-19 pandemic in 2020, the same proportion of funding was allocated to natural hazards and health emergencies, highlighting the significant threat to stability posed by natural disasters.

CERF has approved applications for over US$196 million in the first seven months of 2023 to assist 21 countries following a natural disaster. This is higher than the total annual value for natural disaster funding for eight of the last ten years. The highest allocation of US$40 million was allotted to Syria to provide aid following the 7.8 magnitude earthquake of February 2023.[40]

Sub-Saharan African nations have received the largest share of CERF natural disaster funding every year since the organisation's establishment in 2006. Between January and July 2023, almost US$107 million was allotted to sub-Saharan African countries, with most of the funding directed to drought relief in Ethiopia and Somalia. Sub-Saharan Africa is also the region with the lowest level of Positive Peace, with Somalia recording one of the lowest levels of Positive Peace globally.

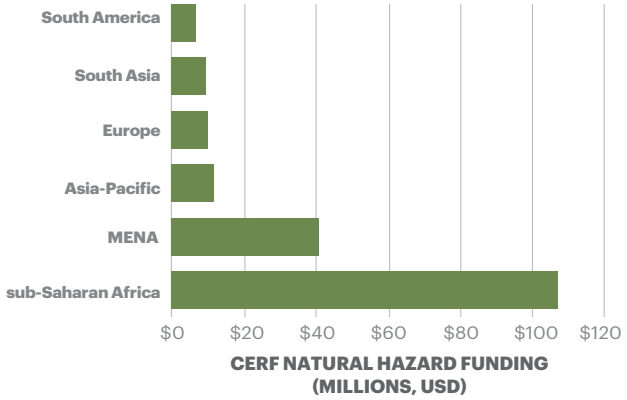
Europe has also experienced an extreme level of drought in the last year, with many parts of the western Mediterranean seeing persistently low rainfall and exceptionally high temperatures for more than a year.[41] Despite this, no European country has been allotted any financial assistance from CERF to aid in drought relief. Europe also records the second highest level of Positive Peace of any region in the world, highlighting the impact of a country's level of resilience on their ability to cope with ecological shocks such as a natural hazard. Funding allocated to Europe in 2023 was solely directed at earthquake recovery in Türkiye, the country with the lowest level of Positive Peace in the region.

CERF has experienced a substantial increase in donations over the last four years. The peak was observed in 2019, with nearly US$830 million donated, a rise of almost 50 per cent compared to the previous year. However, this trend slowed in the subsequent years, with funding fluctuating between US$600 and $636 million in the last three years.

FIGURE 2.18

CERF funding allocations by region, January–July 2023

Sub-Saharan Africa has received 58 per cent of total natural disaster funding in the first seven months of 2023, the most of any region.

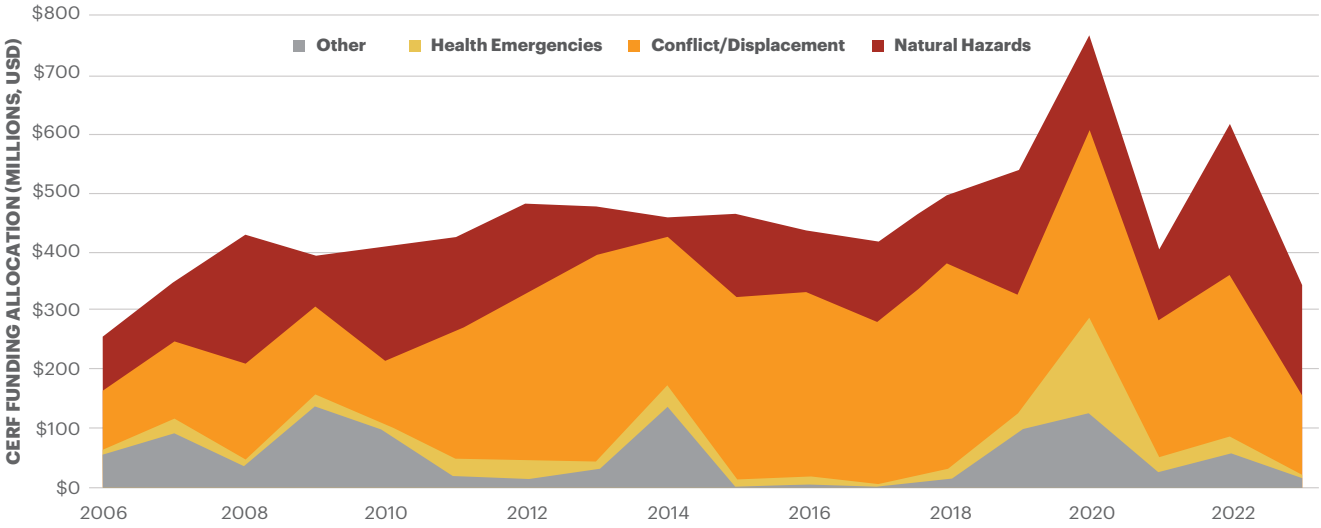


Source: CERF; IEP Calculations

FIGURE 2.17

Distribution of CERF funding by emergency type, 2006–2023

On average, almost a third of CERF annual funding has been allocated to natural hazards since 2019.



Source: CERF; IEP Calculations

Demographic Pressure

Population growth will be a significant ecological threat for many countries in the next three decades. Of the 3,594 subnational areas in the ETR, 631 have a demographic pressure score of 5, meaning that population growth between now and 2050 will be higher than 70 per cent. Population growth is expected to be 20 per cent or higher for over 40 per cent of all subnational areas in the ETR. The geographic distribution of scores on the demographic pressure indicator is shown in the map in Figure 2.19 below.

There is a strong connection between increasing population and environmental degradation, particularly when population growth leads to higher urbanisation and increased economic activity.[42]

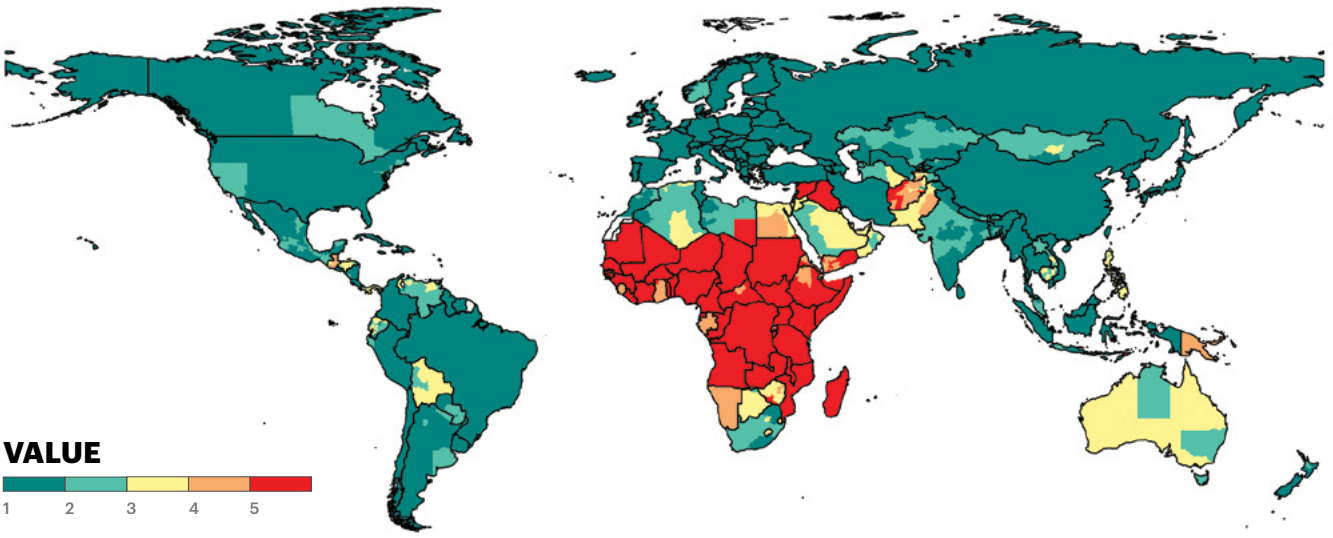
Consistent population growth can increase the chances of conflict breaking out in the future. Most of the world's population growth over the next three decades is expected to occur in the least peaceful countries. The 40 least peaceful countries will have an additional 1.3 billion people by 2050, at which point they will account for just under half of the total world population. This growth will pose major challenges for development and peacefulness. Moreover, the population growth is unlikely to be uniform across countries or regions, or by levels of development and peacefulness, which also means that certain areas will experience greater hardship than others. With resources becoming scarcer, the likelihood of conflict will increase.

Figure 2.20 displays the population projections by level of peace highlighting that most of the population increases will occur in low peace countries.

FIGURE 2.19

Demographic pressure indicator score, 2023 ETR

The sub-Saharan African region is expected to experience the highest population increase globally by 2050.

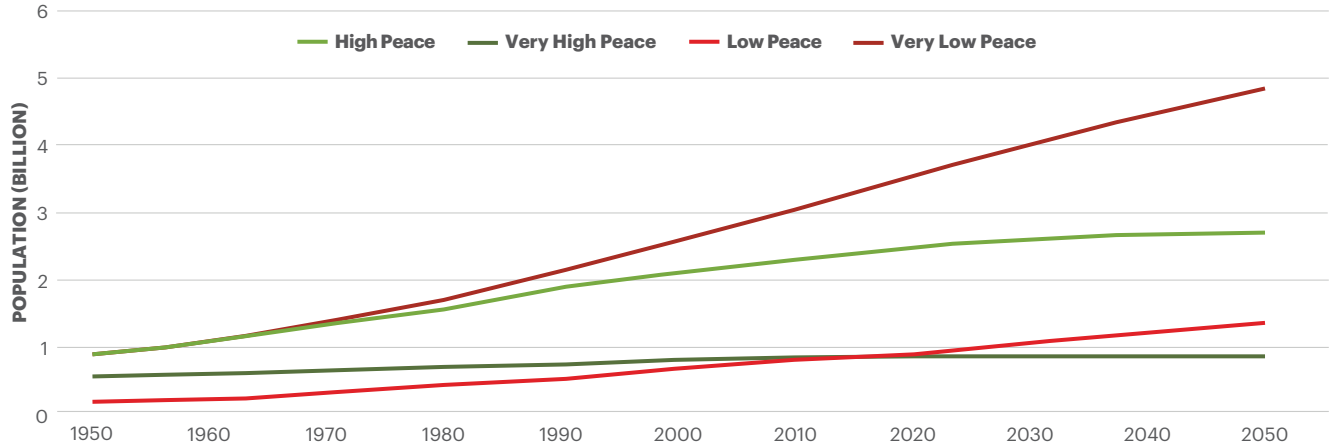


Source: IHME

FIGURE 2.20

Projections of global population by peace level, 1960–2050

Nearly five billion people are expected to be living in very low peace countries by 2050.



Source: IEP

The total global population growth rate between 2020–2050 is expected to be 17 per cent. However, some countries and regions will record growth that is considerably higher. For example, Niger is estimated to record a population growth rate of 146 per cent by 2050, the highest rate of any country. The level of population growth in Niger will outpace economic development leading to a decline in living standards and greater competition for economic resources.

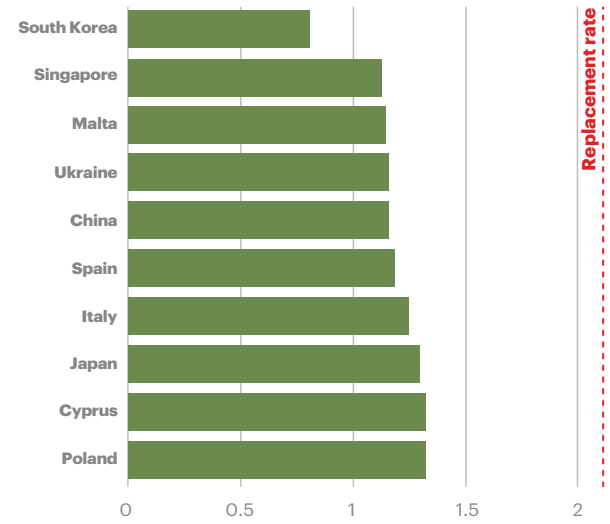
By contrast, in some regions, population growth is expected to be close to zero. Europe and Russia and Eurasia are expected to record population growth rates of less than one per cent. Some countries such as Bulgaria, Latvia and Moldova are expected to see their population fall by almost 20 per cent each by 2050. Only 14 of the 42 European countries are expected to record a positive population growth rate based on current trends without large scale immigration programs.

There are also many countries in the Asia-Pacific region with extremely low projected population growth. Figure 2.21 shows the total fertility rate (TFR) for the ten countries with the lowest levels of fertility in 2021. Of these countries, four are in the Asia-Pacific region and six are in Europe. South Korea has the lowest fertility rate of any country in the world, and is the only country where the TFR is lower than one.

FIGURE 2.21

Ten countries with the lowest birth rate, 2021

South Korea's total fertility rate is now below one.



Source: CERF; IEP Calculations

FOCUS AREA: THE YOUTH BULGE

Increasing and declining populations will have differing effects on the demographic structure of a country. Countries with low or even negative population growth are likely to have a much higher number of elderly people relative to their youth population, while countries with high levels of population growth are much more likely to see a rapid expansion of their population aged 25 or younger. A large increase in the youthful percentage of a population relative to the elderly is known as a 'youth bulge'.

A youth bulge can have significant economic and political complications that can interact with other ecological threats in negative ways, leading to increased fragility, decreasing resilience and a higher likelihood of conflict.

The likelihood of conflict increases when the size of a youth bulge increases. The size of the effect is largest amongst autocratic regimes, however, there is also a large effect amongst fully democratic countries as well.[43] Conversely, a decline in the youth bulge is associated with a fall in the level of terrorism and other types of internal conflict.[44] However, the risk of conflict is not the same for all different types of conflict. An increase in the youth bulge increases the risk of starting non-ethnic related conflict, but does not lead to an increased risk of ethnic conflict.[45]

Youth bulges tend to lead to more political activism amongst the young. Governments that are facing youth bulges are also more likely to implement harsh restrictions on protests, irrespective of the actual amount of protest activity that is taking place.[47] The main mechanism by which youth bulges lead to increased political unrest and a higher risk of conflict seems to be economic, with a surge in the number of young people putting immense pressure on the labour market.[48]

A common way to examine the youth bulge in a country is to look at its population pyramid, which shows the percentage of the population by five-year age groupings. Population pyramids can be categorized into three main types:

- **Expansionary pyramids**, which showcase a larger number of younger individuals indicating high birth rates and potentially lower life expectancies. Countries with a large youth bulge will have an expansionary pyramid.
- **Stationary pyramids**, which display relatively even distribution across age groups signifying stable birth and death rates
- **Contractionary pyramids**, which have a smaller base and a wider top, indicating an aging population with lower birth rates and higher life expectancies.

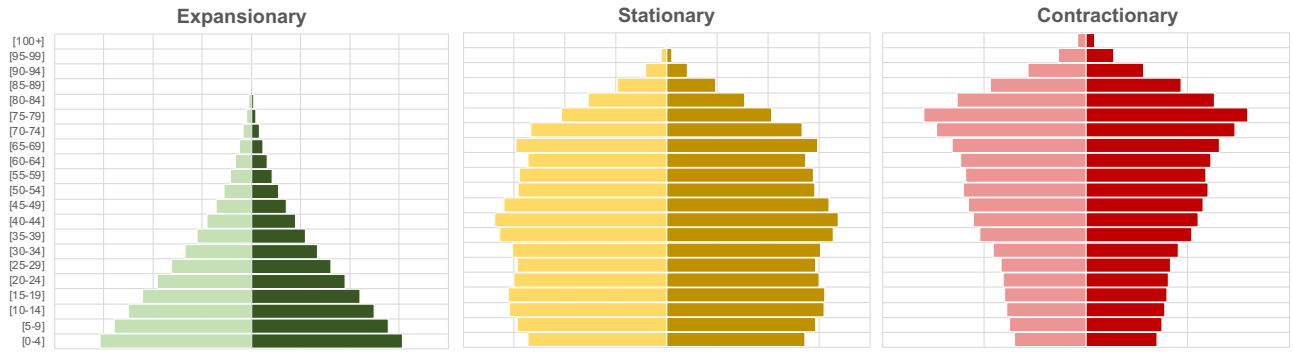
Figure 2.22 gives an example of each of these three types of population pyramid.

Most countries in the world have transitioned from expansionary, to stationary, and then contractionary population pyramids over the last 75 years, indicating a shift towards lower birth rates, longer life expectancies, and a much higher percentage of the population being middle-aged or elderly. Figure 2.23 shows the percentage of countries matching each of the three pyramid types every 25 years from 1950 to 2050. In 1975, close to 70 per cent of countries and territories in the world had expansionary population pyramids, but by 2050, that number is predicted to drop to just three per cent.

However, there is considerable variation across countries and regions. Figure 2.24 compares the shape of the population pyramid at the regional level between 1950–2050. Every region other than North America and Europe had a clearly expansionary population pyramid in 1950. However, by 2050, sub-Saharan Africa will be the only region with a clearly expansionary population pyramid, with every other region having a stationary or contractionary population pyramid. The sharpest transformation over the century will have occurred in the Asia-Pacific region. By 2050 it is estimated one in four people in the region will be aged 65 or older. There are now several countries in the region with sub-replacement fertility, with South Korea having the lowest TFR in the world at 0.8 children per woman.

FIGURE 2.22

Types of population pyramid

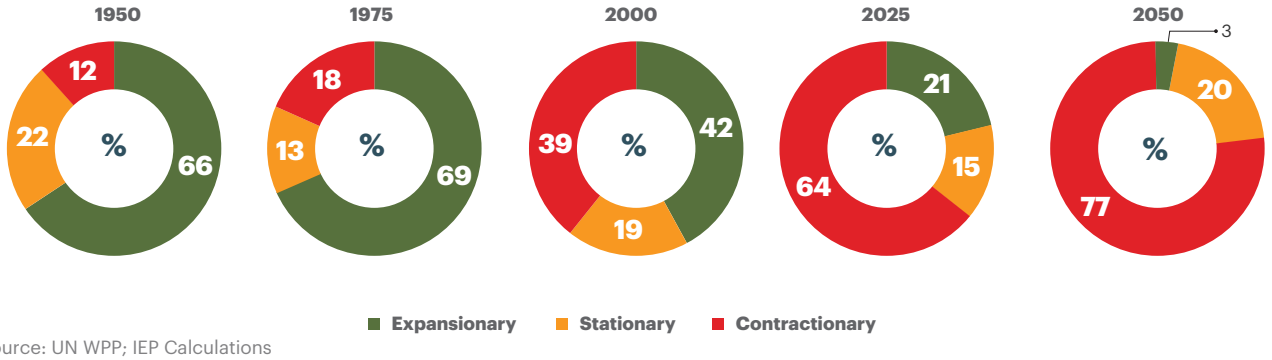


Source: IEP

FIGURE 2.23

Country population pyramids by shape, 1950–2050

By 2050 there will be almost no countries with expansionary population pyramids.



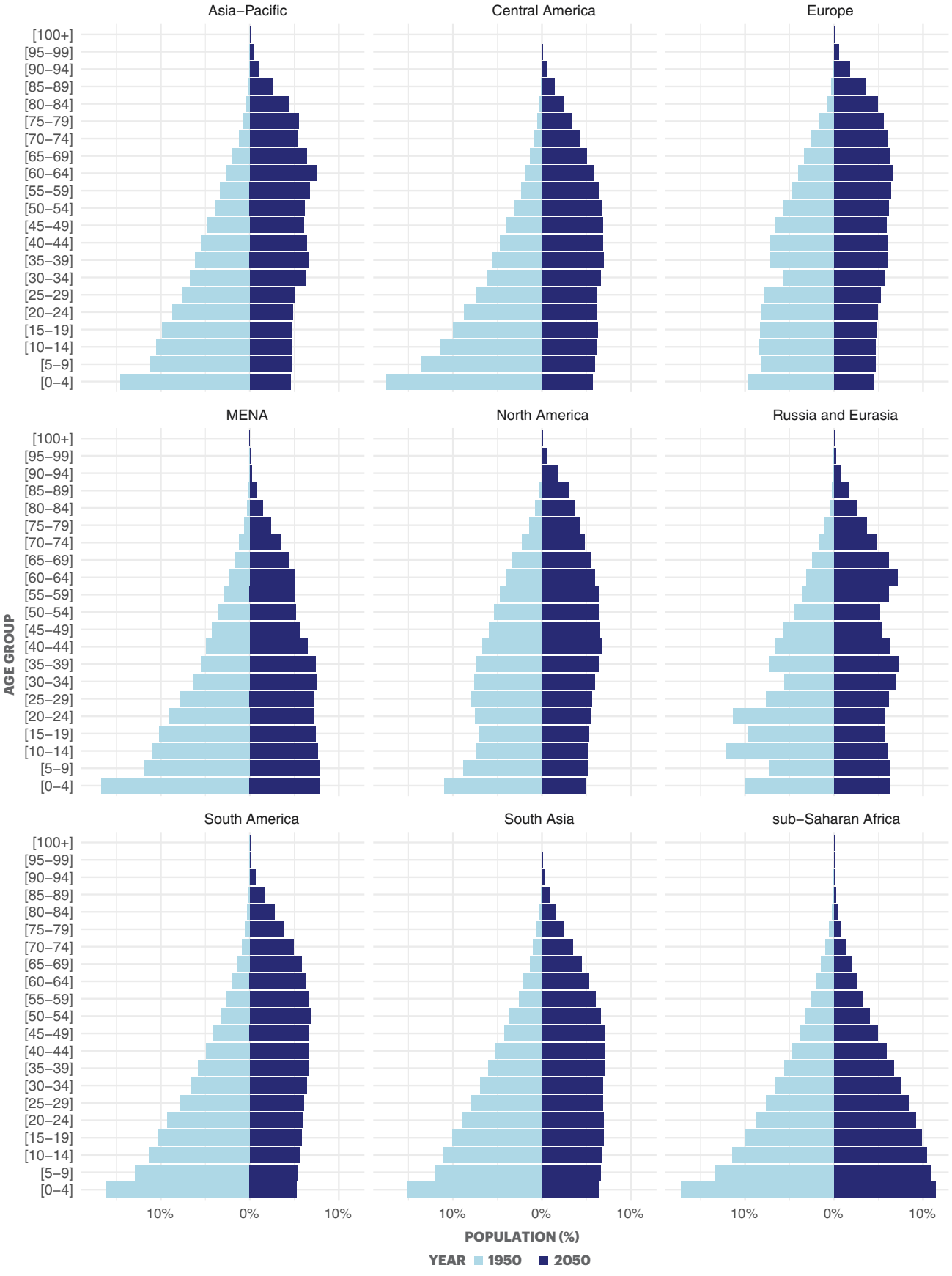
Source: UN WPP; IEP Calculations

> A youth bulge can have significant economic and political complications that can interact with other ecological threats in negative ways, leading to increased fragility, decreasing resilience and a higher likelihood of conflict.

FIGURE 2.24

Relative population pyramid by region, 1950 vs 2050

Sub-Saharan Africa is the only region where the population pyramid is expansionary in 2050.



Source: UN WPP; IEP Calculations

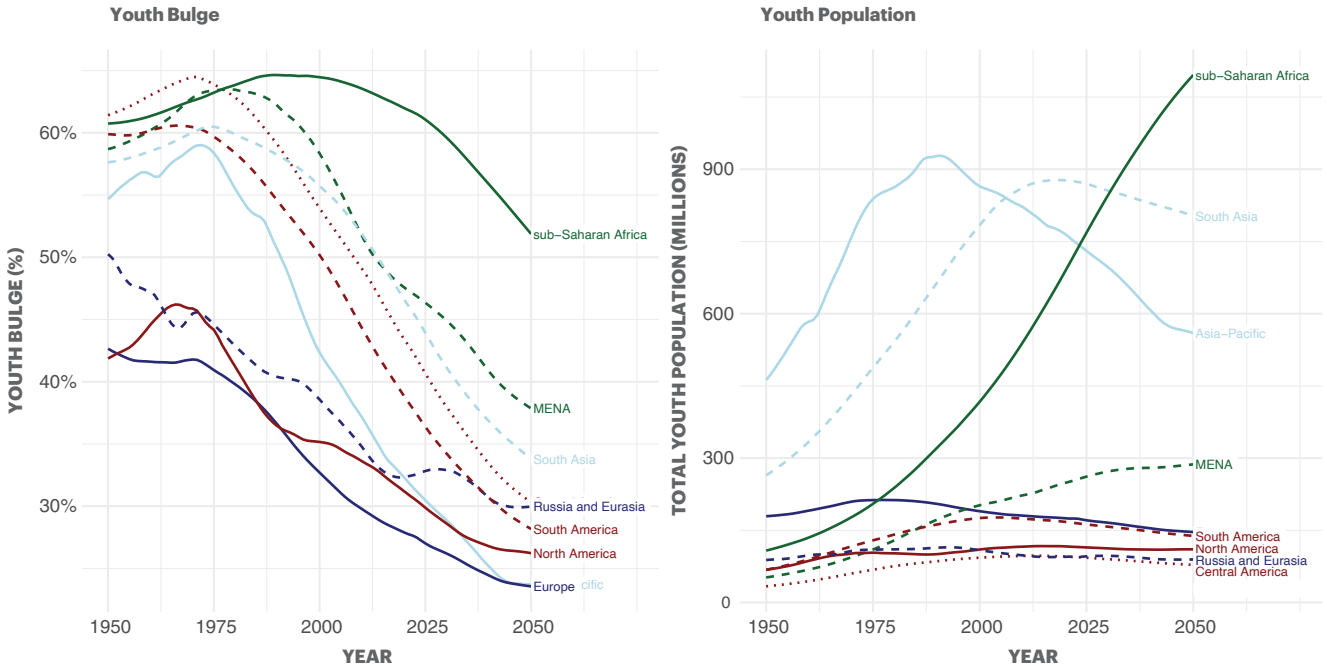
The expanding population of sub-Saharan Africa will lead to a large increase in the number of young people in that region. The number of people younger than 25 in sub-Saharan Africa is already close to 750 million, and is projected to rise to over a billion by 2050, as shown in Figure 2.25. The Middle East and North Africa is the only other region in the world where the total youth population is projected to rise between now and 2050. The growth in the total number of young people in sub-Saharan Africa is so large that in the next two decades, the number of people aged 15 or under in sub-Saharan Africa will be greater than the entire population of Europe.

However, as shown in Figure 2.25, although the total number of young people in sub-Saharan Africa is expected to surge over the next three decades, relative to the overall population in the region the youth bulge as a percentage of total population will fall. In fact, this trend began almost 25 years ago, and has been falling steadily ever since. By 2050, young people as a percentage of the total population in sub-Saharan Africa will have fallen to just over 50 per cent, down from 65 per cent in the year 2000. However, this is still considerably higher than in any other region.

FIGURE 2.25

Youth bulge and total youth population by region, 1950–2050

UN estimates suggest that there will be over a billion young people in sub-Saharan Africa in 2050.



Source: UN WPP; IEP Calculations

3 Conflict, Climate and Ecological Threats

KEY FINDINGS

- The impact of carbon-induced climate change is likely to accelerate over the next 80 years. Data on the relationship between climate change and conflict is limited but will increase in the coming decades.
- The research measuring the direct impact of human induced climate change on armed conflict is still in its infancy. While there is uncertainty on the effect to date, there is agreement that it is likely to accelerate in coming decades. While there is uncertainty on the effect to date there is agreement that it is likely to accelerate in coming decades.
- Shifts in ETR scores are associated with increased risk of conflict. A shift in indicator score of 25 per cent for food insecurity, natural disasters, and water risk increases the risk of conflict by 36 per cent, 21 per cent, and 18 per cent respectively.
- Ecological threats have the biggest impact on conflict in regions like the Sahel, which face major deficiencies in governance and rule of law, high levels of poverty and short-term climatic variations.
- The primary way that ecological threats increase conflict is by increasing competition for resources. However, countries with high levels of resilience and strong institutions are better able to deal with increased resource competition.
- Food insecurity is strongly linked to armed conflict. Areas of high food production are often also areas of significant conflict.
- Ecological shocks that damage livelihoods can increase opportunities for armed extremist groups to recruit new members.
- The transition zone in the Sahel accounts for 7.6 per cent of the total land mass, but just under 16 per cent of total deaths. A transition zone lies between arid landscapes and areas with adequate rainfall.
- Conflict over goods from the global commons like fisheries is increasingly common as demand increases and effects of climate change affect ocean ecology. This is particularly acute during climatic extremes like El Nino events.
- Interstate conflict becomes more likely following rising temperatures or rainfall shocks, especially where states stand to lose from existing agreements on water sharing.
- The impact of climate change on conflict can be overstated compared to the impact of political instability. For example, recent analysis of Lake Chad, has argued that political mismanagement of water resources has played the bigger role in fueling conflict.

The Link Between Conflict, Climate, and Ecological Threats

There is a clear connection between ecological threats, seasonal climatic changes, and armed conflict. The general relationship between these factors can be seen by looking at the correlation between the ETR Overall Score, which aggregates ecological risk into a single score, and the internal peace measure of the Global Peace Index, which aggregates violence and conflict within a nation's borders. This correlation is shown in Figure 3.1. The average level of ecological threat is strongly correlated with internal peacefulness.

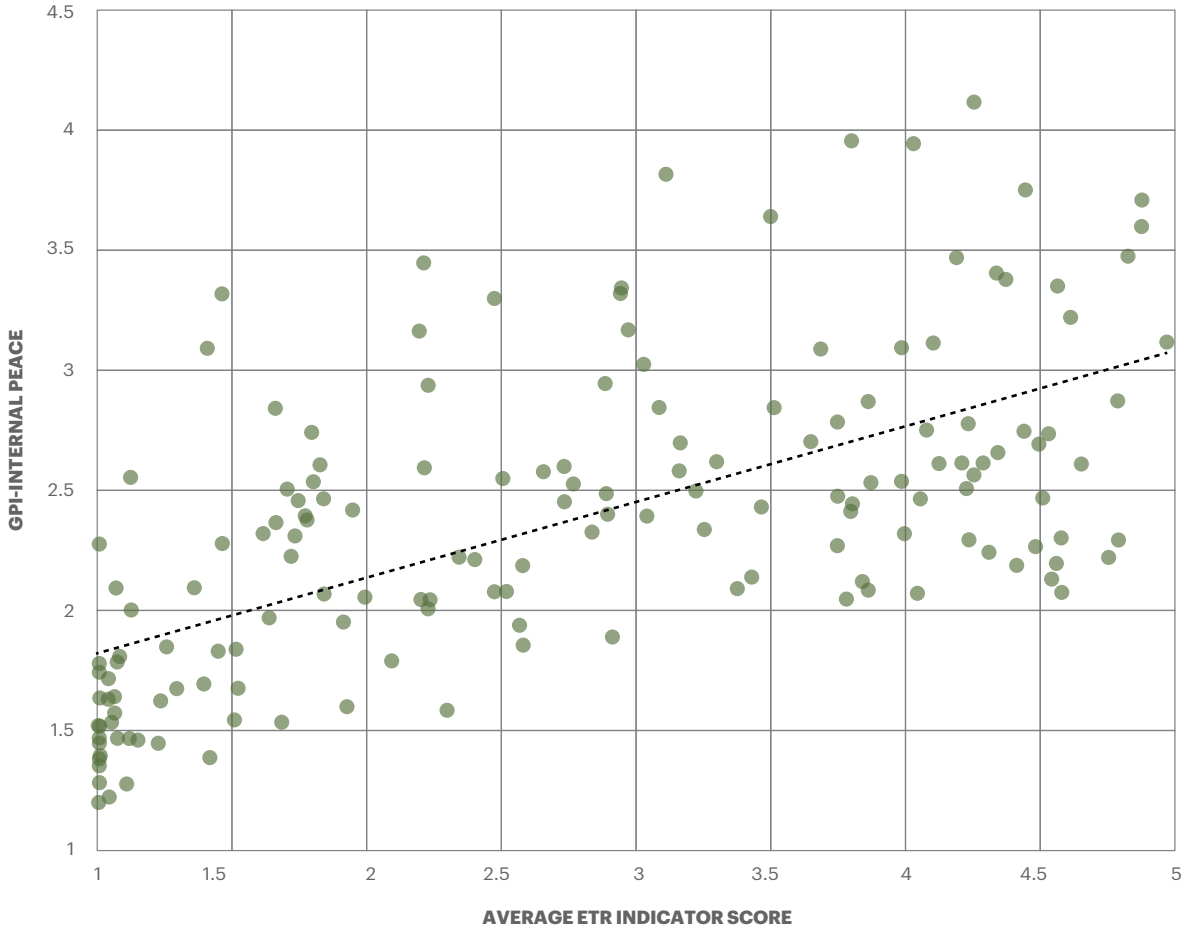
IEP analysis finds that changes in a country's ETR indicators also have a considerable impact upon both conflict onset and duration. A shift in score of 25 per cent has the following impact:

- Increasing food insecurity increased the risk of conflict by 36 per cent
- Increasing natural hazard exposure increased the risk of conflict by 21 per cent
- Increasing water risk increased the risk of conflict by 18 per cent

FIGURE 3.1

Average ecological threat score and internal peace, 2023 (r=0.63)

The average country-level ecological threat score is highly correlated with internal peace as measured by the GPI.



Source: IEP Calculations

These results alone do not outline the way that ecological threats increase conflict risk, nor do they explain the interaction between ecological threat, climate change, and political stability. This section analyses the connection between ecological threat and armed conflict. It considers:

- **What** is known about the overall effect of climate on conflict
- **Which** areas are more likely to see changing conflict risk
- **When** ecological threats are more likely to lead to conflict
- **How** ecological threats affect conflict outcomes

A summary of the findings is shown in Figure 3.2.

Despite the common perception that climate change is directly linked to violent armed conflict, the relationship is more complex. Climate change is often referred to as a 'threat amplifier', and whilst there is evidence to suggest that it makes conflicts worse, it is unlikely to cause them. Rather, the combination of seasonal and long-term climate changes, short-term ecological threats, a history of conflict, a lack of resilience and weak institutions leads to an increased risk of conflict.

WHAT ARE THE OVERALL EFFECTS OF CHANGES IN CLIMATIC CONDITIONS ON ARMED CONFLICT?

Climatic variation and the effects of climate change are widely considered to be drivers of armed conflict. Climatic changes, whether naturally occurring or human induced, have been linked to changes in conflict dynamics in almost all forms of human conflict. A relationship between climate and conflict can be found in data covering the past 10,000 years. For example, severe droughts are associated with the collapses of the Mayan and Angkor empires and dynastic changes in China, while severe cold is associated with instability in Europe during the 17th century. It can be reliably linked to conflicts or violence in every region, as well as in global trends. While the causal pathways are complicated and contextual, the relationship remains robustly linked. For an average increase of one degree in temperature there is a 13 per cent associated increase in intergroup conflict.[1]

There is an important distinction between **natural climate variation and human-induced anthropogenic climate change**. Historically there is a clear relationship between climatic variation or climate change and conflict. The links between anthropogenic climate change and conflict are generally smaller and more contested, but it is highly likely that this relationship, and the magnitude of its effects, increase in the coming decades as global heating intensifies.[2] However, the mechanisms linking changes in climate to changes in armed conflict are indirect and complex. One type of change or event in one part of the world or a country may not have the same or even a similar impact elsewhere.

It is difficult to attribute increased conflict risk to climate change alone. Most empirical climate-conflict research focuses on anomalies like short-term temperature changes or precipitation variations in historical records, rather than long-term climate change itself. It can also be challenging to disaggregate local climatic variation and its effects from anthropogenic climate change. Few studies analyse human induced anthropogenic climatic change and conflict directly.[3] Despite these difficulties, there is consensus that climate change contributes indirectly to armed conflict and that its role is likely to increase in the future. An important factor is the resilience of the societal systems, and the resources available to help cope with the shock. Regardless of the strength of the societal system, if the shock is strong enough then the system will collapse.

WHICH AREAS ARE MORE LIKELY TO SEE CHANGING CONFLICT RISK FROM INCREASING ECOLOGICAL THREATS?

Past conflict is usually the best indicator of future conflict. This is also true when considering the link between climate change, environmental threats and war. Areas already prone to conflict are most at risk, and ongoing conflicts may worsen due to climate change. Figure 3.3 shows areas with high levels of ecological threat in purple, and areas with high levels of battle deaths in orange. Areas shaded in brown have high levels of both conflict and ecological threat.

Regions that are more dependent on agriculture are also more likely to be affected, in particular areas with high levels of subsistence farming. Transition zones, like the Sahel, are particularly prone to conflict. Permanently harsh climatic zones are less likely to experience conflict compared to these transitional zones which experience more variability and are more prone to precipitation shocks affecting important agricultural zones.[4]

Figure 3.4 shows the Sahara transition zone and total conflict deaths in 2020. The transition zone accounts for 7.6 per cent of the total land mass, but just under 16 per cent of total deaths. Nearly 15 per cent of all transition zone areas recorded at least one death, compared to just five per cent of all non-transition zones.

Vulnerability to conflict from ecological shocks is not uniform across different countries and regions. Countries with large populations, low societal resilience and lower levels of development experience higher conflict risk from climate related disasters.[5] At the subnational level, areas with a history of resource-competition-based conflict like Karamoja in Northeastern Uganda are becoming more prone to climate-linked conflicts. These risks are present even with sustained efforts to create peace between different groups.[6] These areas are also affected by high

FIGURE 3.2

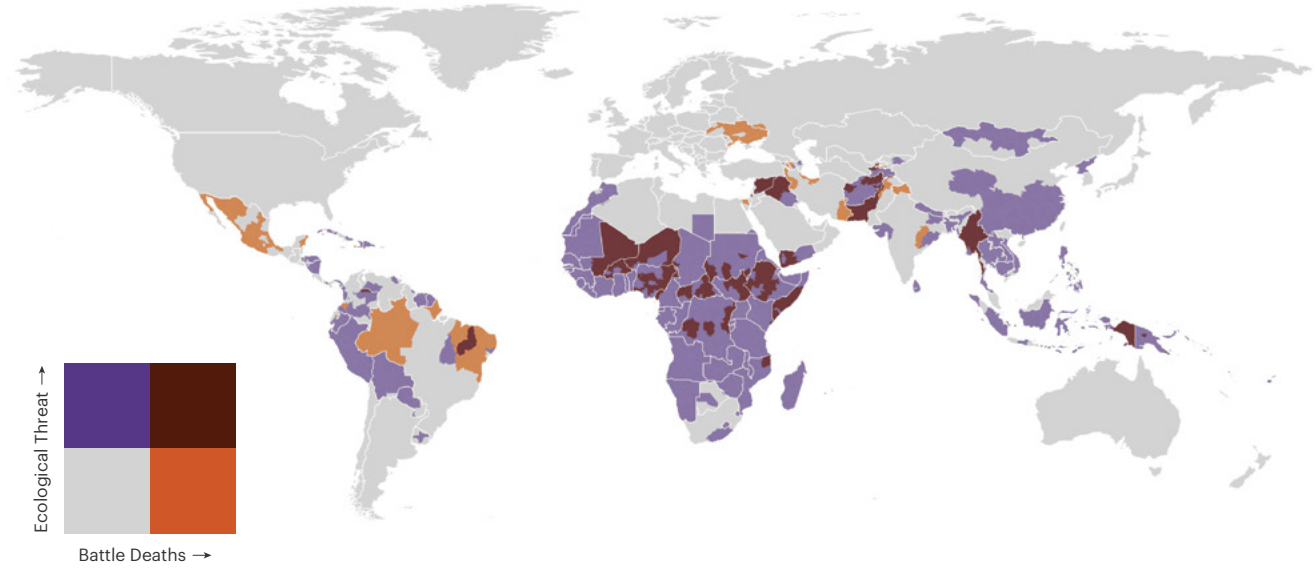
What, where, when, and how ecological threats and climate change influence conflict

What?	Where?	When?	How?
• Ecological threats and climatic changes play a role in exacerbating armed conflict, and this will increase over time.	• In states with lower levels of peacefulness. • In areas with high climatic variability.	• In the aftermath of ecological shocks. • During and after periods of food insecurity.	• By increasing food insecurity. • By intensifying resource competition.

FIGURE 3.3

Subnational ecological threat score and conflict deaths, 2022

Most subnational regions with high levels of ecological threat and active conflict are in sub-Saharan Africa.



Source: UCDP; IEP Calculations

population growth, resulting in a decreasing level of resources per person.

Drought-induced conflicts can also spread to nearby areas where populations are exposed to the effects of the drought.[7]

Occasionally, the impact of climate change on conflict can be overstated. For example, the prevalent theory that the rise of Boko Haram and other extremist groups in Northeastern Nigeria is linked to the shrinking of Lake Chad. However, doubt has been cast on whether Lake Chad is permanently shrinking and some argue that conflict in the region is more closely linked to water management and political factors.[8] Similarly, researchers have questioned the link between conflict over land and climate change in the Mopti region of Central Mali. They have found that weak governance is a more powerful explanation than climate variation or extremes.[9]

Functioning institutions and infrastructure increase resilience and reduce the risk of armed conflict following ecological shocks. In sub-Saharan Africa, flooding is linked to increased communal violence in administrative districts where there is a lack of trust in local institutions. Where local government councils and judicial courts are trusted, there is a reduced risk of intercommunal violence in the aftermath of flood disasters.[10]

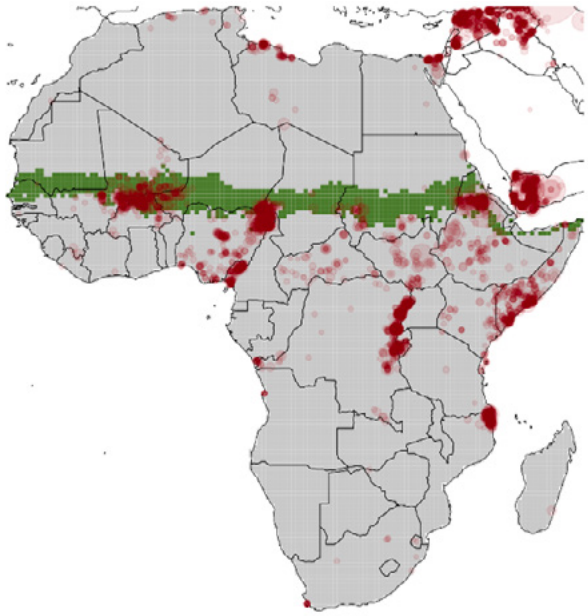
The potential for future conflict between states over water is considerable. The Nile delta and Mekong River systems pose significant challenges and contain nearly half a billion people between them. Egypt is highly reliant on its historical 85 per cent allocation of Nile water to support its growing population of over 100 million. As shown in Figure 3.5, Ethiopia has almost completed the Grand Ethiopian Renaissance Dam (GERD) to fuel its economic growth. The risk of violent conflict involving Egypt and Ethiopia has been considered high in recent years. As of April 2023, the GERD is 90 per cent complete and broader water sharing arrangements are yet to be resolved. Sudan, previously an opponent of the dam, is now in favour of the project as it hopes the GERD will aid management of Nile flooding.

While the likelihood of armed attacks from Egypt is low, as

FIGURE 3.4

The Sahara transition zone and conflict deaths, 2020

15 per cent of transition zone areas recorded conflict deaths, compared to 5 per-cent of non-transition zone.



Notes: Brown denotes areas of conflict, Green denotes transition zone

destruction of the dam would result in catastrophic levels of ecological damage, it remains a key source of tension between countries in the region.[11]

Many other countries around the world rely on large, shared rivers, and poor management of the shared resources could lead to conflict in the future. Another example is the construction of dams on the Mekong, as shown in Figure 3.6.

Six countries share the Mekong River in Southeast Asia, which begins in China. Over 360 million people depend on the Mekong River, including for energy generated by hydroelectric dams. Building dams has required moving communities, and there are major concerns about their environmental and social effects. Cambodia had paused some dam projects because of these concerns but restarted one in 2022. Dam plans near the Thai-Laos border face opposition from neighbouring countries, locals, and NGOs.

WHEN DO ECOLOGICAL THREATS AFFECT CONFLICT?

FIGURE 3.5

Nile river dams

Water-sharing arrangements between states remain a source of tension in the Nile River Basin as construction of the Grand Ethiopian Renaissance Dam is reaching its completion.

Source: Natural Earth Data

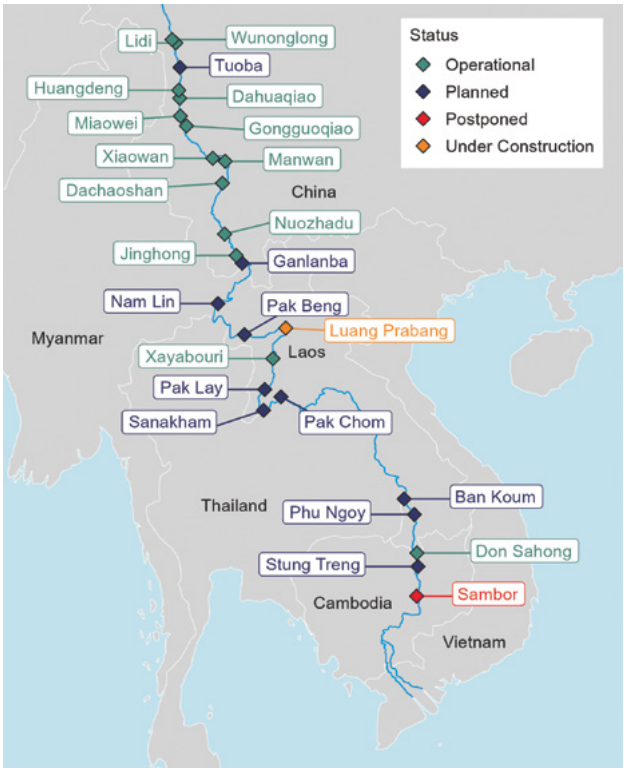
The impact of climate change and ecological threats on armed conflict is affected by temporal dynamics and seasonal issues like crop production and rainfall cycles. This is particularly the case for food insecurity. For example, during the Syrian Civil War dry conditions during growing seasons were linked to an increase in government-initiated attacks.[12] In the Sahel, areas that produce cash crops experience a twofold increase in non-state actor attacks during their peak productivity times.[13]

Large-scale natural hazards such as cyclones, large storms, earthquakes and tsunamis can increase the risk of conflict. This is especially true in areas with political exclusion of ethnic groups, low levels of economic development, and large populations.[14] One example is shown in Figure 3.7. Higher levels of violence against civilians in Mozambique's Cabo Delgado conflict were associated with the effects of cyclones in March and April 2019.[15] Conflict-related deaths rose by 174 per cent in the year following the cyclones.

FIGURE 3.6

Mekong river dams

Planned Mekong River dams in Thailand, Laos and Cambodia have been delayed by cross-border contestation and concerns about their environmental and social impact.

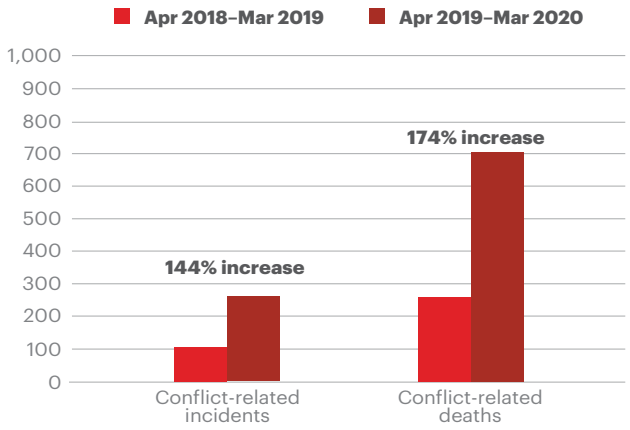


Source: Open Development Mekong, Mekong River Commission

FIGURE 3.7

Change in conflict-related incidents and deaths in Cabo Delgado, Mozambique, 2019–2020

Conflict-related deaths increased by 174 per cent in the year following two major cyclones in March and April 2019.



Source: ACLED

Food security and competition for resources may also play a role in interstate conflict. There is global concern for climatic effects on fish stocks. Food security in China and Japan depends on the supply of fish in the East and South China seas. Climate change may strain oceanic ecosystems, raising the risk of conflict, especially during severe weather events like El Nino. These seas are already contested by China, Taiwan, Japan, Vietnam and the Philippines. Conflicts over fisheries could lead to unexpected violence, especially when unregulated fishing vessels are involved.[16]

WHY AND HOW DO ECOLOGICAL THREATS IMPACT CONFLICT?

Figure 3.8 outlines the relationship between ecological threats and the risk of conflict. The specific causal pathways vary spatially and temporally. Armed conflicts tend to escalate where natural disasters induce changes in the relative power of conflict parties, for instance by facilitating recruitment or decreasing income. By contrast, if one conflict party is weakened by a disaster and the other lacks the capability to exploit this vulnerability, armed conflict intensity declines.[17]

Resource competition is common but ongoing conflict can exacerbate levels of competition for limited resources. In cases of ecological shocks, antipathy towards politically salient outgroups can increase in the immediate aftermath of a disaster.[18] There also appears to be a role for resilience in explaining variations in support for political violence between households. For example, In North Kivu in the Democratic Republic of the Congo, households with greater resilience tend to show less support for political violence and are less likely to partake in such actions. By contrast, for households with low resilience, experiencing a drought has been linked to an increase in support for political violence.[19]

Food security is crucial for understanding how climatic changes can affect patterns of armed conflict. When non-state groups rely on local revenue, it can dictate the timing and location of their attacks. In the Sahel, rebel and militia activity doubled in cash-crop areas, while state forces didn't increase their attacks. This indicates that non-state groups are more reliant on local revenue, and they might use violence to seize resources based on demand.[20]

Violence against civilians across sub-Saharan Africa was shown to be lower in situations of high food security and to increase during periods of food insecurity.[21] There are several reasons for this. During times of food scarcity, food can be a significant recruitment tool for armed groups. Rising food prices can also escalate the operational costs for insurgent groups. As a result, these groups could forcefully take food from civilians, leading to increased harm to the civilian population.[22]

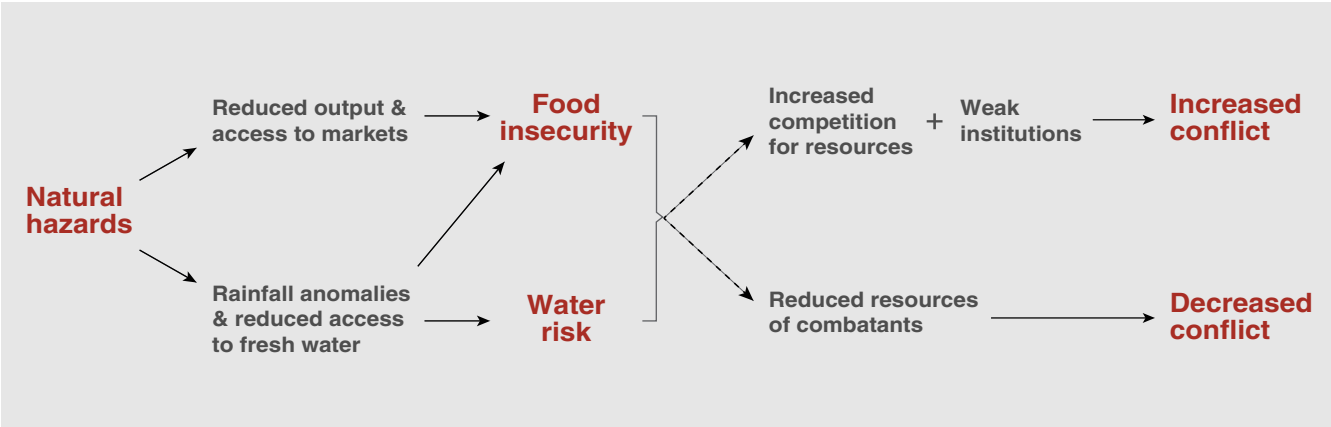
Food insecurity also has a strong impact on recruitment in civil wars. Where armed groups can provide alternative livelihoods, as well as security, there is a strong incentive for young people to join. The recruitment of children into non-state armed groups is associated with positive temperature deviations.[23] In agriculture-dependent regions, climate variability reduces farming income and household sustenance. Armed conflict worsens these conditions, making participation in pro-government militias a more viable option as an alternative livelihood.

The effect of cyclones in Mozambique's Cabo Delgado conflict shows that the type of conflict, actor ideology and strategy are important for understanding why disasters have diverse effects on armed conflict. Natural disasters in areas where insurgencies do not have a strong local support base more likely to lead to violence against civilians.[24]

FIGURE 3.8

Relationship between natural hazards, food insecurity, water risk and conflict

Increased competition and weak institutions turn ecological threats into increased conflict.



Source: IEP

4 Megacities and Migration

KEY FINDINGS

- There are currently 33 megacities in the world, meaning cities with a population of ten million or more. By 2050, there are projected to be at least 50.
- The percentage of people globally living in urban areas is expected to grow from 54 per cent to 70 per cent by 2050. The number of people living in cities will grow by 2.5 billion by 2050.
- In 2050, the three largest megacities in the world are expected to be Mumbai, Delhi and Dhaka with populations of 42 million, 36 million and 35 million, respectively. More than 60 per cent of the world's current megacities are in low or very low peace countries. 267 million people live in megacities with very low peace. There is a significant negative correlation between projected megacity growth and their level of peacefulness.
- While the percentage of people living in informal settlements or slums has fallen in most low-income countries, it has increased in fragile and conflict affected states (FCAS). Nearly 55 per cent of the urban population in FCAS areas live in informal settlements.
- Most of the countries with the biggest population growth in cities do not have the financial resources to manage the growth. Both Nigeria and the Democratic Republic of the Congo are large countries with multiple high population growth cities and low per capita income.
- Urban expansion can have a detrimental effect on its surrounding areas. Total global cropland is forecast to shrink by 1.8 to 2.4 per cent by 2030 because of increasing urbanisation.
- Population growth in urban areas has exacerbated many existing environmental, social, political and economic issues, including higher concentrations of pollution, more pronounced socio-economic differences and overwhelming existing infrastructure.
- In 2019, the economic impact of air pollution reached US$ 8.1 trillion, equivalent to around six per cent of the world's total economic output. Over 90 per cent of deaths from pollution occured in low to middle-income countries.
- In 2019, the five most air polluted cities had readings 16 times higher than the WHO recommended annual limit; Lahore recorded 25 times, Kabul 24 times, Hetian Shi 23 times, Hapur 22 times and Agra 22 times. All five cities are in Asia.
- Of the 20 most polluted cities globally, only three are not in India or China.
- Most of the world's megacities are in countries with low levels of peacefulness. Of the 33 megacities, 21 are in countries with low or very levels of peacefulness.
- Most of the world's megacity growth will take place in Africa and Asia. Eight of the ten largest megacities will be located in these regions in 2050.
- Megacities in Africa face significant environmental challenges. Of the ten largest megacities in the region, nine are facing at least one severe ecological threat, other than population growth.
- Migration and displacement will be major issues for megacities in the near future. The number of forcibly displaced people in the world now stands at over 108 million.
- Most refugees and displaced people move into cities. More than 60 per cent of all refugees and 80 per cent of internally displaced people move to cities.
- The ETR data reveals that a significant portion of illegal crossings between 2020 and 2022 originated from countries facing severe food and climate insecurity, rapid population growth and water risks. Specifically, 25.3 per cent of the crossings were attributed to Syrian nationals, with Afghan nationals making up nine per cent.

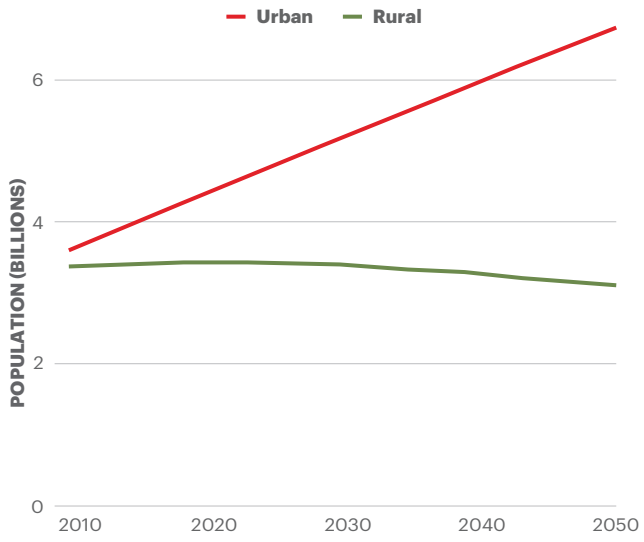
Introduction

As the world's population continues to grow, so does the proportion of people living in urban areas. The percentage of people living in urban areas is expected to grow from 54 per cent to 70 per cent by 2050, with the total population in urban areas increasing by 2.5 billion.[1] As shown in Figure 4.1, the world's rural population will decline slightly, while the urban population will grow steadily, highlighting that all the population growth that occurs in the next 25 years will take place in cities.

FIGURE 4.1

Projected population growth 2010-2050, urban vs rural

All of the world's population growth will occur in urban areas.



Source: IEP; OWID; Masanobu Kii 2021

There are many benefits to increasing urbanisation. City living offers many advantages and is often associated with increased job opportunities, higher incomes, increased use of technology and higher levels of education. Businesses in urban areas can enjoy lower input costs, greater collaboration and increased innovation opportunities.

The most urbanised countries are usually the most developed, have low population growth and are generally, more sustainable. There are also a range of benefits to government, which include lower service delivery costs and increased accessibility for residents. Table 4.1 lists the 50 cities that are expected to be megacities in 2050.

It has become evident that when cities grow too fast, they can become unstable, with population growth outpacing infrastructure development. This can lead to increases in crimes, poverty, slums and other informal residences, increased traffic congestion, pollution and a general strain on public services. This is especially true for cities located in low-income countries and ones with low societal resilience.

Many of today's cities were not designed to accommodate the large number of people who now live in them. This means that many have not addressed or are not prepared for the ecological, environmental, infrastructural and security challenges that emerge with rapid urbanisation, especially when migration originates from hardship and not personal choice. Some of the fastest growing

TABLE 4.1

Megacities in 2050

City	Country	Projected 2050 Population	Country per Capita Income (PPP)
Mumbai	India	42,403,631	8,379
Delhi	India	36,156,789	8,379
Dhaka	Bangladesh	35,193,184	7,395
Kinshasa	Congo, DRC	35,000,361	1,337
Kolkata	India	33,042,208	8,379
Lagos	Nigeria	32,629,709	5,860
Tokyo	Japan	32,621,993	45,573
Karachi	Pakistan	31,696,042	6,437
New York City	United States	24,768,743	76,399
Mexico City	Mexico	24,328,738	21,512
Cairo	Egypt	24,034,957	15,091
Manila	Philippines	23,545,397	10,133
Sao Paulo	Brazil	22,824,800	17,822
Shanghai	China	21,316,752	21,476
Lahore	Pakistan	17,449,007	6,437
Kabul	Afghanistan	17,091,030	1,674
Los Angeles	United States	16,416,436	76,399
Chennai	India	16,278,430	8,379
Khartoum	Sudan	15,995,255	4,216
Dar es Salaam	Tanzania	15,973,084	3,097
Beijing	China	15,972,190	21,476
Jakarta	Indonesia	15,923,577	14,653
Bangalore	India	15,619,514	8,379
Buenos Aires	Argentina	15,546,223	26,505
Baghdad	Iraq	15,087,672	10,862
Hyderabad	India	14,611,856	8,379
Luanda	Angola	14,301,327	6,974
Rio de Janeiro	Brazil	14,287,336	17,822
Nairobi	Kenya	14,245,579	5,764
Istanbul	Turkiye	14,175,543	37,274
Addis Ababa	Ethiopia	13,212,273	2,812
Guangzhou	China	12,996,279	21,476
Ahmedabad	India	12,431,006	8,379
Chittagong	Bangladesh	12,211,707	7,395
Chicago	United States	11,925,691	76,399
Ho Chi Minh City	Vietnam	11,860,301	13,457

Lima	Peru	11,571,387	15,048
Bogota	Colombia	11,555,257	20,287
Shenzhen	China	11,196,456	21,476
Paris	France	11,124,389	55,493
Bangkok	Thailand	11,079,598	20,672
Tehran	Iran	10,998,668	18,075
Pune	India	10,923,535	8,379
Abidjan	Cote D'Ivoire	10,708,876	6,538
Kano	Nigeria	10,444,151	5,860
Wuhan	China	10,255,365	21,476
Moscow	Russia	10,235,265	36,485
Osaka	Japan	10,188,099	45,573
Tianjin	China	10,149,945	21,476
Sana'a	Yemen	10,052,562	3,437

Source: Global Cities Institute

cities in sub-Saharan Africa, South Asia and elsewhere have raw sewerage on the streets, poor garbage or no garbage collection and lack safe drinking water. They are more likely to have high levels of petty crime as well as organised crime, and corruption is rife.

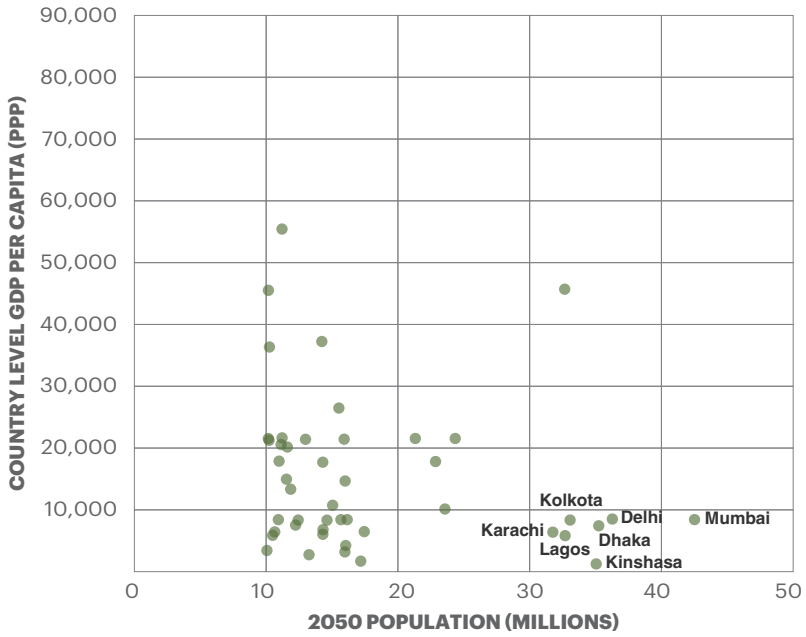
Figure 4.2 shows the correlation between the expected megacity population size in 2050 and the current country-level per capita income in PPP terms. There are eight cities with projected populations in 2050 of over 30 million people. Of these cities, only Tokyo has national level GDP per capita of over 10,000 USD in PPP terms. GDP per capita in The Democratic Republic of the Congo, home to the city of Kinshasa, is less than 1500 USD.

The high level of population growth expected in these cities, coupled with low per capita income and the associated low levels of tax revenue and other financial resources, is likely to place a significant strain on the ability of these cities to manage future growth.

FIGURE 4.2

2050 Megacities: population vs country level GDP per Capita (PPP)

Only one country with a projected population of over 30 million has per capita income over 10,000 USD in PPP terms.



Source: World Bank; Global Cities Institute; IEP Calculations

The urbanisation trend has also exacerbated many existing environmental, social, political and economic issues, including higher concentrations of pollution, more pronounced socio-economic differences and overwhelming existing infrastructure. This is evident in many cities in South Asia and sub-Saharan Africa, where those that can afford to live in well-serviced neighbourhoods, while migrants live in over-crowded and under-resourced slums. These issues could have a direct impact on societal peacefulness and personal peacefulness as the lack of job opportunities, hygiene, food and water create a breeding ground for dissatisfaction which can stoke conflict.

This is particularly true in countries which are already fragile or conflict affected, as shown in Figure 4.3. While the percentage of the urban population living in slums or informal developments has fallen in low-income countries over the past twenty years, it actually increased in fragile and conflict-affected countries over the same time period. In fragile countries with low resilience, nearly 55 per cent of the urban population live in informal settlements.

There are various pull and push reasons for migration to cities. Many of the push factors in rural areas are identified in the ETR including environmental degradation, resource scarcity, conflict and especially rapid population growth. Rapid population growth means that farm sizes become untenable as land inheritances shrink the size of a working lot, which is especially noticeable in parts of Africa. In such cases, people seek to escape insecurity and hardship by moving to urban centers, but when they get there, rapid growth means they face a myriad of challenges, such as overcrowding, weak employment opportunities, poor sanitary facilities, food insecurity, lack of access to freshwater water, congestion and pollution.

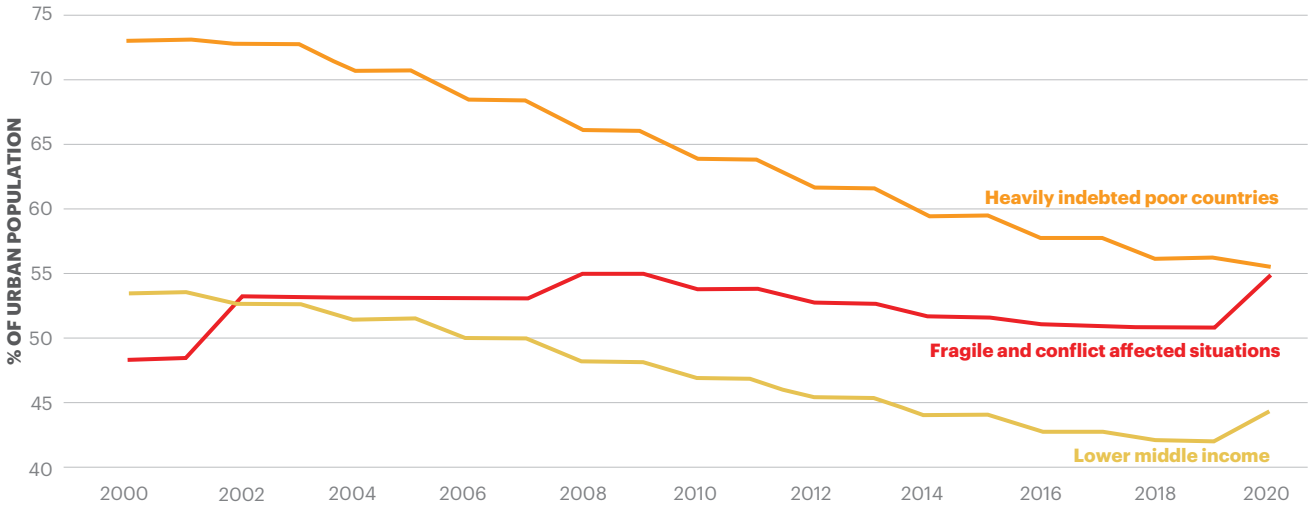
In these environments, city authorities face a complex set of challenges because on one hand, there is a persistent flow of people, as seen for example in Dhaka, which witnesses between 1500 to 2000 migrants daily, but their infrastructure or employment opportunities to accommodate such a large movement of people is not present.

On the other hand, the growth of cities has a direct effect on the surrounding areas. Cites are generally strategically located close to transport routes and high-quality farming land. As they expand, they tend to take over the agricultural land, reducing available land for food production. This was evident in a 2016 study, which projected that by 2030, urban expansion will result in a 1.8 to 2.4 per cent loss of global croplands, with approximately 80 per cent of the losses occurring in Asia and Africa.[2]

FIGURE 4.3

Percentage of urban population living in slums or informal settlements, 2000–2020

Living in slums is now just as common in fragile states as in heavily indebted poor countries.



Source: World Bank; Global Cities Institute

Megacities

Over the last century a new type of city has emerged–the megalopolis or megacity–which is defined as a city that is home to ten million people or more. In the 1950s, there were only two megacities, New York and Tokyo. There are currently 33 megacities globally, which will grow to at least 50 by 2050.[1]

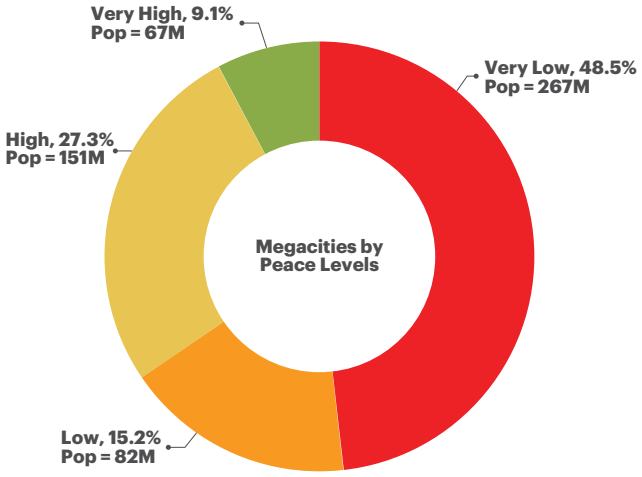
The majority of megacities in the world are found in countries with low levels of peacefulness, as shown in Figure 4.4. Just under half of the world's megacities are found in countries with very low levels of peacefulness, and less than ten per cent are found in countries with very high levels of peacefulness. Thus, many of the world's megacities are already facing high levels of crime, homicide, terrorism and other issues associated with societal safety and security.

Most of the projected future growth in megacities between now and 2050 is expected to take place in cities that are found in countries with low levels of peacefulness. There is a significant correlation between projected megacity growth and the peace levels of the country the megacity is in, as shown in Figure 4.5. The two cities with the highest levels of country peacefulness, Osaka and Tokyo, are both projected to have population declines over the next couple of decades.

FIGURE 4.4

Proportion of megacities by peace levels

More than 60 per cent of the world's current megacities are in low or very low peace countries.

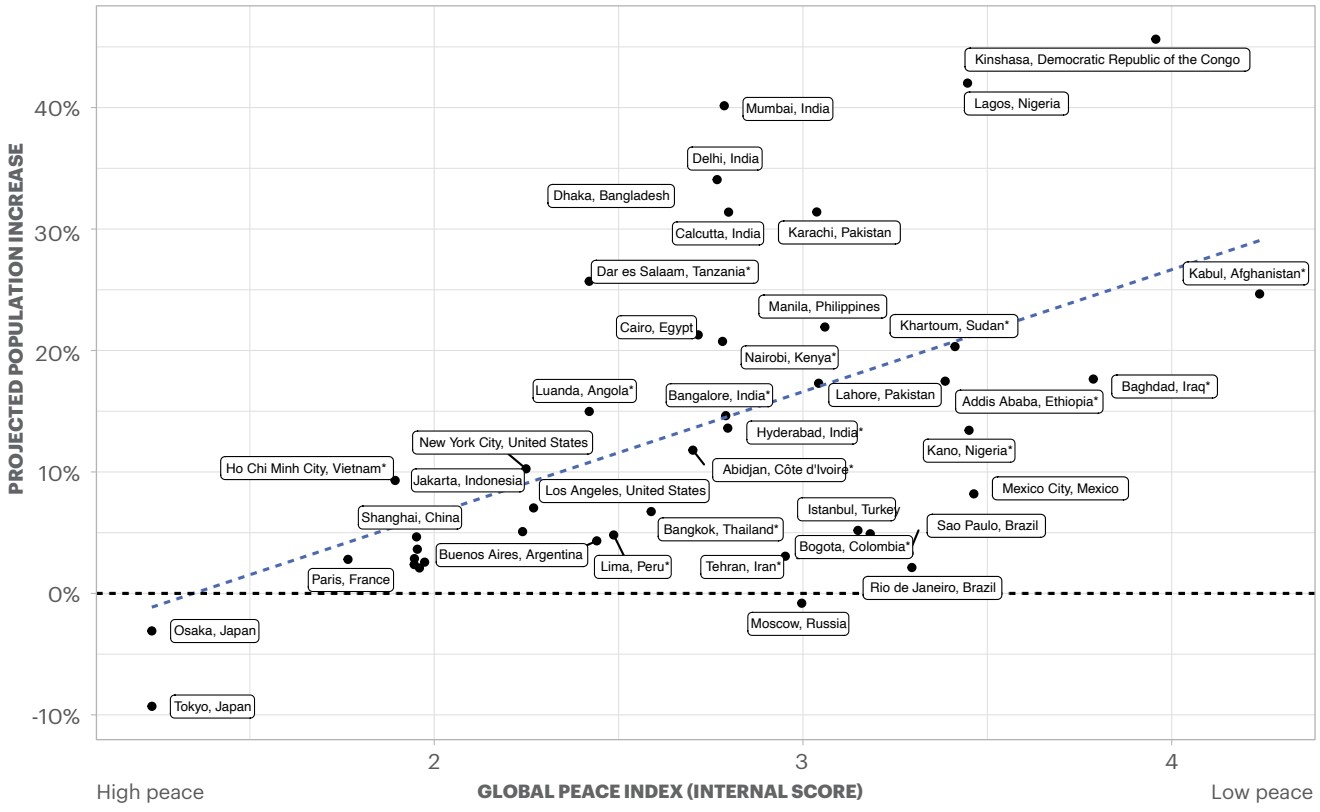


Source: Global Cities Institute

FIGURE 4.5

2050 megacities: projected population growth by peace level

Megacities in lower peace countries are projected to experience higher population growth than those in higher peace countries.



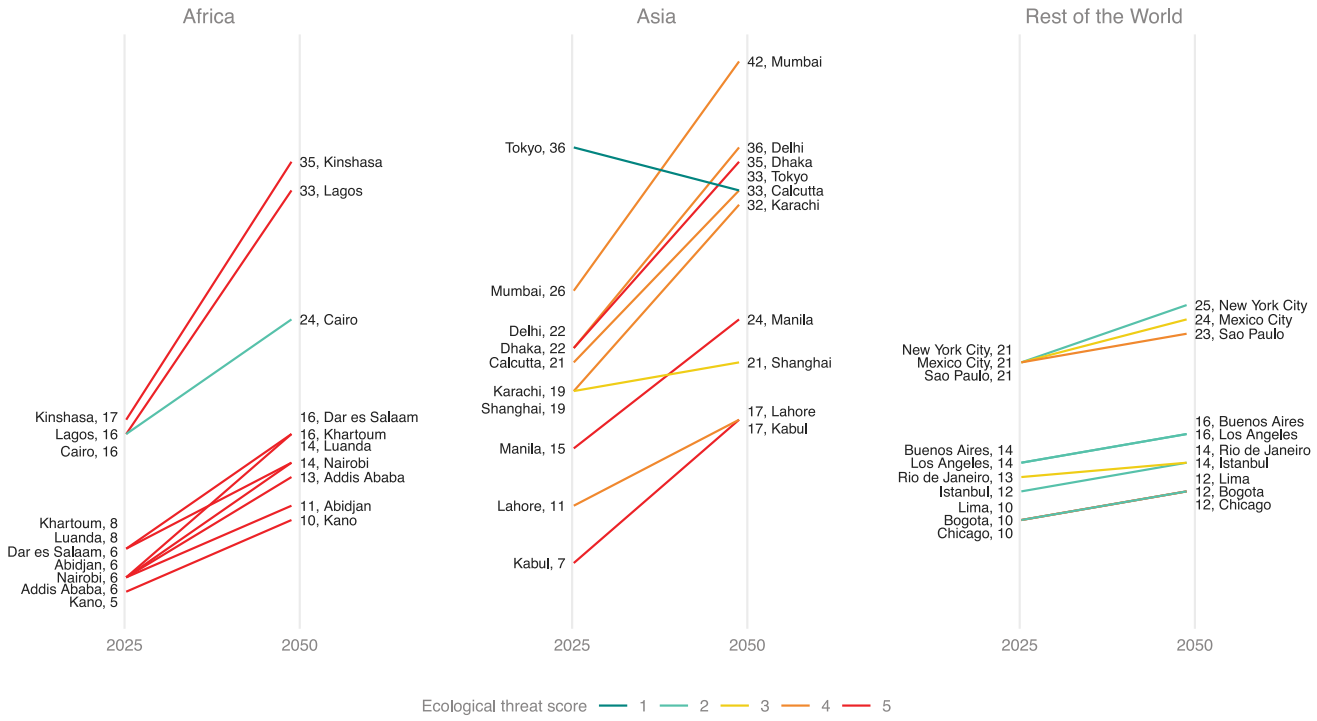
Source: Global Cities Institute; IEP

Most of the projected growth in cities will not only take place in megacities with low levels of peacefulness, but also in cities that are found in subnational areas, facing a high level of ecological threat. Figure 4.6 shows projected growth in megacities for Africa, Asia and the rest of the world. Eight of the ten largest megacities in the world in 2050 will be in Africa or Asia, and only two of these cities are not facing at least moderate or high ecological threat. Of the ten largest megacities in Africa in 2050, nine are currently facing at least one severe ecological threat other than population growth.

FIGURE 4.6

Projected population growth in megacities: Africa, Asia, rest of world (2025–2050)

Eight of the world's ten largest megacities will be in either Africa or Asia.



Source: Global Cities Institute; IEP

Ecological Challenges to Cities

The rapid growth of megacities in areas with low levels of peacefulness and high levels of ecological threat poses a significant challenge to the future sustainability of these cities. There is a real danger that without substantive and systemic reforms, some of these cities will become unsustainable. This is especially true for cities suffering from water shortages, cities that have unreliable food supply chains and cities already suffering from civil unrest.

In some cases, the issues are so great that the cities will need to be abandoned and new cities will be built. For example, one reason why Indonesia is building a new capital – Nusantara – is because parts of Jakarta are sinking at a rate of 1.8 and 10.7 centimetres per annum.[2]

The Pakistani capital, Islamabad, is an example of a city that had attempted to plan for urbanisation. However, because of large unplanned increases in its population, Islamabad is facing a number of challenges ranging from catastrophic flooding, to sanitation, and lack of clean water. It also faces threats from ecological changes that include food insecurity and rising water stress.[3]

FOOD INSECURITY AND WATER RISK

Food insecurity and water risk are particularly strong challenges for cities. While over 70 per cent of the planet is covered in water, less than three per cent of it is freshwater.[4] Many cities are already facing large scale disruptions due to their scarce water supply. In 2018, for example, Cape Town's four million inhabitants faced the prospect of turning the taps on and having no water. The city authorities responded by getting inhabitants to reduce consumption from 780 megalitres per day in early 2018 to under 550.[3]

Mexico City highlights a different challenge, which is subsidence. Mexico City is the fifth biggest megacity, home to over 20 million people and expected to increase to 24 million by 2030. The city was constructed atop Lake Texcoco, the primary source of its water. As the city extracted this water, it created vast cavities, causing sections of the city to sink by roughly 50 cm annually. As the population swelled due to migration, nearby freshwater lakes were drained to make space for newcomers. This change forced the city to import about 40 per cent of its water from remote sources. Inadequate management, coupled with insufficient investments in infrastructure like rainwater collection, has resulted in significant water loss due to leaks and the mixing of freshwater with sewage. Consequently, one in five inhabitants only has access to tap water for a few hours during the day.

INFRASTRUCTURE

Rapid urbanisation puts significant pressure on a city's infrastructure. Some estimates suggest that 57 trillion dollars will be needed by 2030 to deal with informal settlements, with an estimated one billion people expected to be living in housing with subpar sanitation.[4] The effects of these infrastructural challenges are particularly evident in Africa and Asia. These regions, due to intense urbanisation, have seen a surge in informal settlements and the loss of farmland and green spaces.

The pace of urban growth, combined with planning practices, will result in a shortfall of public amenities such as libraries, schools and healthcare facilities for incoming populations. The unpredictability of migration patterns complicates urban planning since migrant destinations change based on currently available and desirable areas. Moreover, many rapidly growing megacities lack the financial capacity and skilled workforce to effectively address these infrastructural demands.

Two primary concerns stemming from swift urbanisation are congestion and overcrowding. Many global cities have ill-equipped transportation systems for their current demand. Mumbai's rail system, for instance, during peak hours, serves over three times its intended passenger capacity.[5] This overcrowding results in severe safety concerns, with passengers sometimes falling from crammed train carriages. Additionally, congestion leads to significant time losses in traffic. Congestion is also a major contributor to air pollution.

POLLUTION

Urban areas with dense populations significantly contribute to pollution. This pollution affects not only the immediate environment but also contributes to global pollution through the dispersal of air and water contaminants. In 2021, it was estimated that cities contributed to around 70 per cent of global CO2 emissions.[6] This is concerning as air pollution results in six to nine million premature deaths, each year.[7]

In 2019, the economic impact of air pollution reached US$ 8.1 trillion, equivalent to around six per cent of the world's total economic output.[8] Notably, over 90 per cent of deaths due to pollution happened in low to middle-income countries. These nations face the brunt of pollution because they often lack the means and infrastructure to combat its effects compared to wealthier countries.

Table 4.2 shows the 20 cities with the highest levels of pollution. In 2019, the five most air polluted cities had readings more than 20 times higher than the the WHO recommended annual limit of 5 micrograms per cubic meter; Lahore recorded 25 times the WHO limit, Kabul 24 times, Hetian Shi 23 times, Hapur 22 times and Agra 21.9 times. All these five cities are in Asia.

TABLE 4.2

20 most polluted cities, 2019

City	Country	PM2.5 (microns/m3)	Level Above WHO Recommendations
Lahore	Pakistan	123.88	24.8
Kabul	Afghanistan	119.77	24
Hetian Shi	China	112.3	22.5
Hapur	India	111	22.2
Agra	India	109.67	21.9
Noida	India	105.25	21.1
Delhi	India	105	21
Muzaffarpur	India	101	20.2
Ghaziabad	India	100.67	20.1
Baghpat	India	92	18.4
Kashgar	China	90.23	18
Zhanhe Qu	China	89.6	17.9
Shunhe Huizuqu	China	88.27	17.7
Muzaffarnagar	India	86.5	17.3
Dhaka	Bangladesh	86.48	17.3
Xinfu District, Xinzhou	China	83.39	16.7
Dongchangfu Qu	China	82.12	16.4
Kashi Shi	China	81.75	16.4
Asansol	India	81	16.2
Chuzhou Shi	China	80.79	16.2

Source: IEP

Of the twenty most polluted cities, nine are in India, and a further seven in China. China highlights the migratory trend and the challenge that many urban centres in low-income countries face as they look to industrialise. China's drive to urbanise has been strong, rising from 16.2 per cent in 1960 to 61 per cent, in 2020. This urbanisation drive highlights why the country is home to at least 15 megacities and over 110 cities with a population of a million or more.[6] It is also evident that these cities face many challenges in adapting to ecological threats.[7]

MIGRATION

Migration will be a considerable challenge for rapidly growing cities in the near future, especially as a result of forced migration and population displacement. The number of displaced people is now at a record high level, as shown in Figure 4.7. There were over 108 million forcibly displaced people as of the end of 2022.

Most displaced people end up in cities. It is estimated that 60 per cent of refugees and 80 per cent of internally displaced people are living in urban areas, up from an estimated 30 per cent in 1990.[8]

The average length of time that somebody is displaced is also increasing, from an average of nine years in the 1990s, to over two decades in 2023.

Many refugees are displaced into neighbouring countries, rather than making longer trips into countries or regions further away. As a result, if neighbouring countries and areas are dealing with similar types of ecological threats, displaced people might be fleeing ecological threats like food insecurity or water risk, only to end up in other areas dealing with the same risks. In the case of cities, this could lead to large migration inflows that place strong pressure on infrastructure frameworks that are already under severe strain.

This can be best shown by looking at the contrast in ETR scores between regions with the largest refugee and asylum seeker flows. When looking at refugee flows between 2020 and 2023:

- 28 per cent moved to countries with higher levels of natural disaster risk.
- 22 per cent of refugees moved to countries with higher levels of water risk.
- 18 per cent moved to countries with higher levels of food insecurity.
- 9 per cent moved to countries with higher levels of conflict.
- 7 per cent moved to countries with lower GDP per capita.

Thus, while the majority of refugees moved to countries with lower levels of conflict risk and better economic prospects, a very significant proportion of refugees moved to countries with increased natural disaster risk. A smaller, but still substantial proportion also moved to countries with higher levels of water risk or food insecurity. Given that most of these refugees ended up in urban environments, many of which are already struggling with infrastructure, food security, and access to fresh water, this trend could lead to a severe strain being placed on major urban environments in developing countries.

INFORMAL AND ILLEGAL MIGRATION INTO THE EU

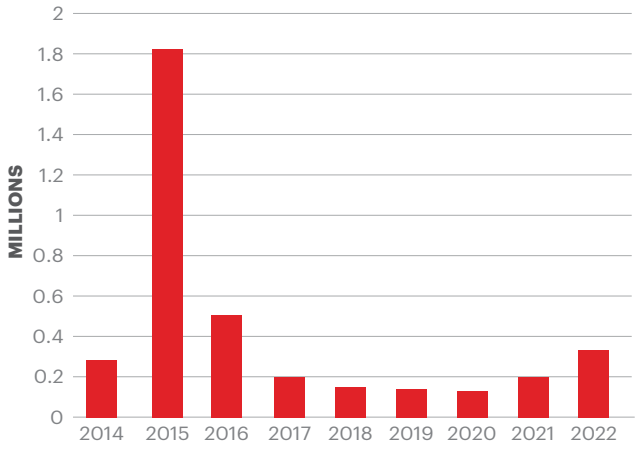
Most refugees end up in neighbouring countries or regions. However, there have been large numbers of refugees moving from the Middle East and North Africa into Europe over the past decade. Although these numbers fell considerably following the peak of the refugee crisis in 2015, there has been an increase in the number of informal and illegal migrants into Europe in the past three years.

Since 2020, the EU Schengen Zone has experienced a significant rise in illegal border crossings. This increase stands in stark contrast to the subdued legal migration levels observed during the COVID-19 pandemic. By 2022, the number of illegal crossings were the highest since 2016 when people fled the conflicts in Syria, Afghanistan, and Iraq. Between 2020 and 2022, illegal crossings into EU Schengen Zone increased by 161 per cent, with 657,641 cases recorded over the three-year period.[9] Additionally, the European Border and Coast Guard Agency (FRONTEX) reported nearly 13 million Ukrainian refugees entering the EU in 2022, a figure separate from the illegal immigration statistics.[10]

FIGURE 4.8

Detected irregular external border crossings to the EU (2014–2022)

In 2022, detected illegal crossings into EU reached the highest level since 2016.

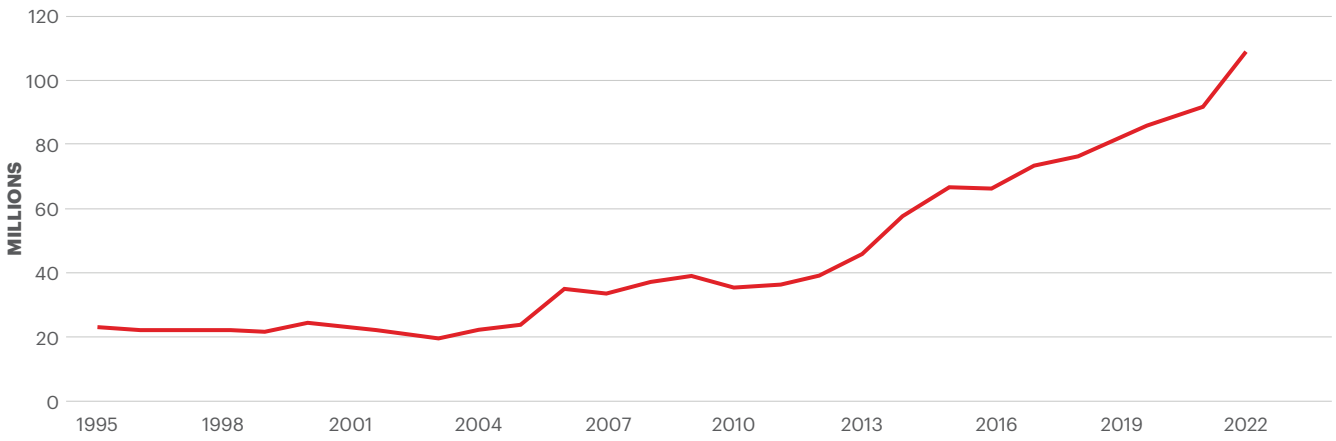


Source: IEP

FIGURE 4.7

Forcibly displaced people, 1995–2002

The number of forcibly displace people has increased over fivefold in the past two decades.



Source: UNHCR

The EU has identified several primary irregular migration routes, reflecting the complex patterns of human movement. These routes, influenced by factors such as border controls, geopolitical events and evolving conflicts, include:

- **Eastern Mediterranean**: Sea and land crossings primarily from Turkey.
- **Western Mediterranean**: Routes from Morocco and Algeria leading to Spain.
- **Western Balkan**: Land pathways from Greece into Central and Western Europe.
- **Central Mediterranean**: Sea routes to Italy and Malta originating from North African countries and Greece.
- **Western African**: Sea routes targeting the Canary Islands.
- **Circular**: A route circulating between Albania and Greece.
- **Eastern Borders**: Land crossings from countries like Russia, Belarus, Ukraine, and Moldova.

From 2014 to 2022, the Eastern Mediterranean and Western Balkan routes were the main entry points for irregular migrants into the European Union, with each route observing over a million migrants. During the 2015-2016 crisis, the Eastern Mediterranean route became particularly significant, primarily due to individuals fleeing conflicts in Syria, Iraq, and Afghanistan. This route has also been recently favoured by Afghans and Nigerians. Between 2020 and 2022, the Western Balkan route accounted for 35 per cent, 232,654 crossings, of the total, while the Central Mediterranean route represented 32 per cent or 208,958 crossings) as shown in Figure 4.9.

The COVID-19 pandemic brought about changes in migration patterns. The Eastern Mediterranean route saw a 47 per cent increase in activity between 2018 and 2019, but this was followed by a 76 per cent decrease from 2019 to 2020. In 2022, a notable shift occurred: the Western Balkan route, popular among Egyptians, Tunisians and Bangladeshis, surpassed the Central Mediterranean for the first time since 2019.

While migration increased along the EU's southern borders over the past two years, both the West African and Eastern routes witnessed significant declines. Specifically, crossings on the Western Mediterranean route dropped from 56,245 in 2018 to 15,134 in 2022, with most migrants on this route coming from Northwest African countries.

Geopolitical factors play a crucial role in these migration trends. Many irregular migrants pass through multiple non-EU countries before reaching an EU border. The European Union's agreements with certain nations, such as Tunisia in 2023, Libya in 2018 and Turkey in 2016, have also significantly impacted migration dynamics.

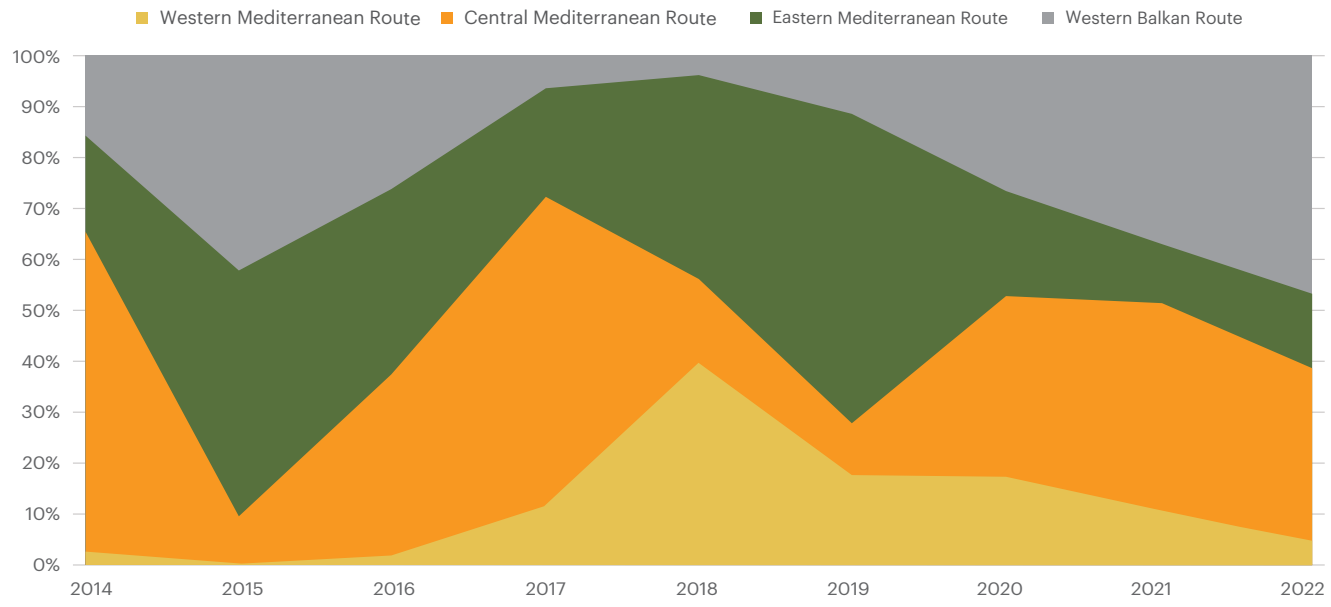
While ecological threats are not the primary cause of illegal crossings into the EU, they are a key secondary factor. The ETR data reveals that a significant portion of illegal crossings between 2020 and 2022 originated from countries facing severe food and climate insecurity, rapid population growth and water risks. Specifically, 25.3 per cent of the crossings were attributed to Syrian nationals, with Afghan nationals making up 9.6 per cent. Collectively, individuals from Syria, Afghanistan, Tunisia, Morocco, Algeria, Egypt, Bangladesh, Turkey and Pakistan made up just over 67 per cent of the total illegal border crossings between 2020-2022.

The relationship between ecological threats, climate change and migration is complex. While ecological threats can exacerbate political unrest and conflicts, their direct connection to migration is multifaceted. Syria, for instance, faced severe droughts before its civil war, which intensified existing vulnerabilities, leading to unrest. Since 2009, over one million Syrians have sought refuge in the EU. Similarly, countries like Afghanistan and Bangladesh, grappling with multiple ecological challenges, have seen increased migration to the EU.

FIGURE 4.9

Evolution of key routes for irregular migrants into the EU (2014–2022)

In 2022, the crossings via the Western Balkan route exceeded those through the Central Mediterranean route for the first time since 2019.



Source: FRONTEX; IEP Calculations

5

Policy Recommendations

ECOLOGICAL THREAT POLICY SEMINARS

In 2021, IEP held a series of six policy seminars with 60 leading experts from governments, think tanks, military institutions and development organisations to explore policy options to address increasing ecological threats. A series of key themes emerged that spanned action from the local to the international level. These are summarised as follows:

Building resilience. Resilience building is *holistic*, involving all aspects of a societal system. Part of this holistic approach is recognising the multilayered links between ecological change, sustainable development, human security and global action. Faced with such complexity, international agencies need to develop a common understanding on the meaning of 'resilience.'

Broaden the range of actors involved. Stronger multilateral cooperation with a wider group of actors is also required for *interventions based on systems thinking to be successful.* Modern global governance is characterised by an increase in non-state actors, who in many cases, form a large part of program implementation. It is therefore important that proposed solutions ensure their inclusion and input.

Security and development. In states with the worst threat levels and lowest societal resilience, ecological challenges will act as a 'threat multiplier' and worsen instability. This can cause increased conflict and encourages spill-over into neighbouring countries and regions. Some of these effects include new conflicts and population displacement into other regions, as well as economic dislocation. Focus should be on interventions that mitigate or reduce the risk of conflict.

The scope of the problem is beyond the budget capabilities of all the international agencies combined. As institutional funding decreases, it is clear that private sources need to be leveraged to reduce reliance on taxpayer resources. The sum of all national governments' income is 15 per cent of world GDP.[1] Only a small proportion of government income can be directed towards ecological adaptation and development. Therefore, these issues must be faced with not only governments and NGOs, but also the private sector. For example, if global pension funds were to allocate just one per cent of their assets to ecological threat resilience building programs, the investment would constitute around $500 billion. This is more than three times the OECD's annual allocation in official development assistance (ODA) and would go a long way towards averting more serious humanitarian crises and economic disruptions.

Solutions to ecological problems require short-term costs with long-term benefits. Adapting to increasing ecological shocks requires sectoral reallocations. As with any budgetary restructure, there will be winners and losers. For example, decarbonisation to mediate long-term temperature change means moving away from carbon-intensive sectors, which many countries heavily depend on. As sectoral reallocations will negatively impact certain workers, businesses and investors, there needs to be further analysis of its effect on these groups (for instance coastal farmers and coal miners).[2] In regions with already low resilience, the ability to successfully navigate this transition will be further hindered by tight budgets.

Many of the solutions to ecological problems can generate income, such as the provision of water which can then be used to grow food. If business can clearly see how to garner a profitable return from ecologically positive investments, funds will naturally flow towards ecological solutions.

Develop community cooperatives. Due to the strong bonds within communities, cooperatives can work well. Cooperatives provide a mechanism for the pooling of resources and sharing of costs. Many examples exist including shared water resources, seed and fertiliser banks, and micro-manufacturing plants.

A key overarching implication of these discussions is **the need to empower local communities to address the contextual challenges they face**. Community-led approaches to development and human security lead to better program design, easier implementation and more accurate evaluation. Initiatives that are led by locals usually benefit from more accurate local knowledge, deeper awareness of local sensitivities and usually enjoy greater community buy-in. Thus, such initiatives tend to run more smoothly and at lower research and implementation costs than others. They also avoid the "one size fits all" approach of top-down interventions. Designed effectively, these bottom-up approaches can work in tandem with programs initiated at a higher level by governments and multilateral organisations.

SYSTEMS PLANNING: THE HALO APPROACH

While successful developmental programs can be implemented in isolation, a better outcome can be achieved when a well-planned set of interventions is developed from a systems perspective. Programs will yield better outcomes if the successes of each are designed to underpin the success of the others. The resulting system of projects will yield results greater than the sum of each of the projects. For a successful fully systemic approach many other aspects would need to be considered, including security responses, governance initiatives and community engagement.

Further, in creating systemic change, smaller "nudges" are preferable to large scale interventions. A large scale mistake is difficult to recover from, whereas minor changes can be undone more easily, even if they are numerous. In addition, drastic changes – even those in the right direction – can be disruptive and, in extreme cases, destabilising for the system. In defining interventions, it is better to attempt to do many small nudges, rather than large, fundamental changes to the status quo.

What has emerged from the IEP Policy Seminars is that in most cases governments, multilaterals and other institutions engaged in societal development initiatives do not address their initiatives systemically. This can create unforeseen consequences and lead to only partially successful outcomes, since there is not a wider understanding of the dynamics of that society. If institutions themselves are not set up systemically it can lead to issues including inefficiencies, partial solutions, inter-organisational disagreements and duplication.

To achieve systemic and sustainable outcomes, there needs to be a common understanding of how the system currently operates and what the desired change is. Currently there is no agreed holistic process for stakeholders to conduct a collective mapping system of operation.

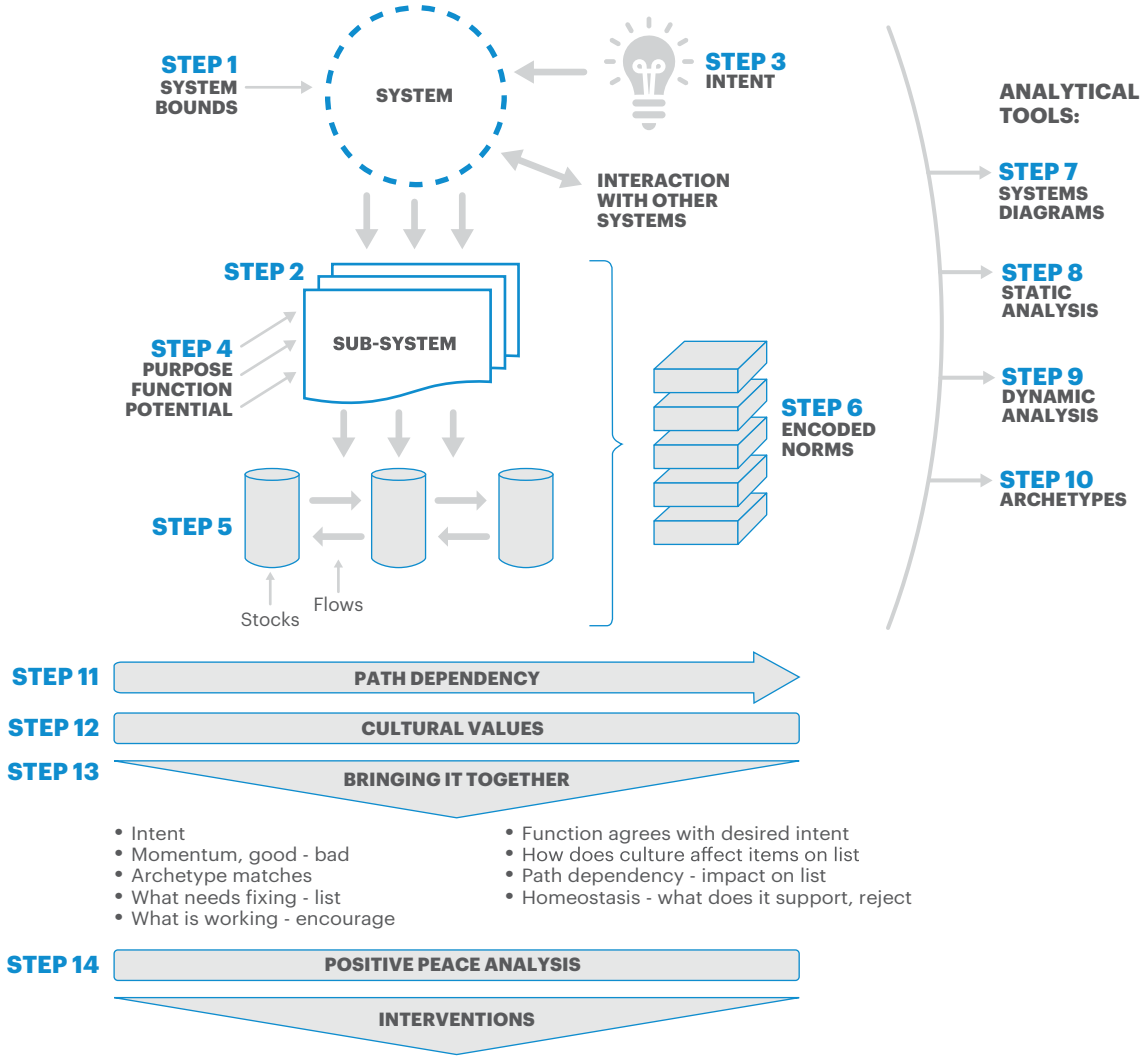
In 2021, in recognition of this gap, IEP developed and published a process to allow practitioners to build a more holistic systems picture of societal issues. Called HALO, it presents a set of 24 building blocks for the analysis of societal systems and the design of resilience-building programs. It guides the user through 14 steps as shown in Figure 5.1. This allows for an adaptive approach that can be uniquely tailored based on dependencies including the size of the societal system and the sophistication required in the analysis.

HALO workshops and programs can be as short as two days or as long as one year using this building block approach. Different building blocks can be utilised depending on the strengths of the design team, what may suit the project best, and the length of time allocated for the analysis.

FIGURE 5.1

Schematic illustration of IEP's HALO systems analysis

This stylised summary depicts the key attributes of a system and helps analysts map each attribute to a real-world scenario that is under analysis.



Source: IEP

A full HALO systems analysis provides knowledge to help design the interventions that need to be performed to rectify the imbalances within the system and set it on a new course. For a more detailed explanation of the HALO approach, please consult the 2022 Positive Peace Index.[3]

INNOVATIVE DEVELOPMENT

This section provides a series of localised programs that have had success in building resilience against ecological threats. These include addressing ecological rehabilitation, improving water sources, managing population growth and building local industry. Some of these projects have been implemented by IEP's sister organisation The Charitable Foundation (TCF).

Countries more vulnerable to resource scarcity have lower coping capacities to manage resource scarcity shocks. These countries also tend to have unsustainable population growth, low or volatile economic growth, high rates of poverty, lack of societal resilience and greater prevalence of food insecurity. With this in mind, there is a clear need for building more resilient and sustainable food and water systems in communities vulnerable to resource scarcity. This can look like more efficient water capture infrastructure or community-based programs connecting smallholder farmers to finance systems or mobile apps that inform farmers of changing weather patterns.

FOSTERING WATER RESILIENCE

Sand Dams

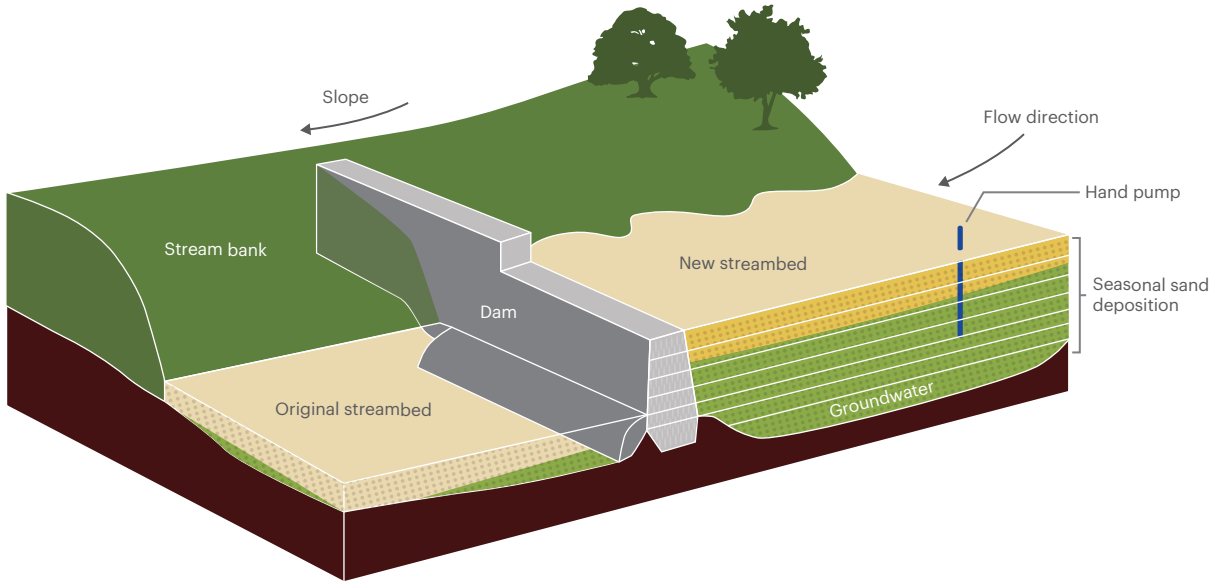
Abstraction of water from sandy seasonal riverbeds is an ancient practise where natural dikes capture the water stored in the sand. Subsurface dams and sand dams are artificial enhancements to natural dikes, which if constructed carefully last for an exceptionally long period of 50 to 100 years.

A sand dam is a dam built in a seasonal dry riverbed onto bedrock or an impermeable layer. It is constructed across the river channel to block the subsurface flow of water through the sand. The upstream reservoir of such a dam can be composed of 40 per cent water when made up of coarse sand. The water can then be retrieved for multiple uses including domestic purposes, livestock and irrigation. The captured water also seeps into the banks of the river increasing the vegetation and biodiversity. The cost to build one of these dams is approximately $50,000.

FIGURE 5.2

Schematic diagram of a sand dam in Kenya

For the cost of $50,000, a sand dam can produce water to the value of $180,000.



A very large sand dam can hold 71,000 cubic metres of water (71 million litres) which when amortised over 10 years will yield water for 29c per thousand litres. Large dams can yield 400 tonnes of produce. Based on World Health Organisation (WHO) estimates, this is enough for 2,790 people's fruit and vegetable requirements. A study done on sand dams in Kenya estimates the value of 400 tons of produce to be around 20 million shillings ($180,000).

The return on investment will vary depending on the crops and price of staples at the time. TCF has conducted a detailed feasibility study which is publicly available.

In many locations of TCF projects, little or no agriculture was being undertaken before the installation of the sand dam. Subsequent agricultural activity has been central to uplifting the regions.

TCF has built 30 sand dams in Kenya and is exploring ways of scaling the benefits through establishing the business case for investing in the construction of sand dams.

Dispensers for Safe Water in Zomba, Malawi

This project was developed by Evidence Action to install chlorination dispensers at water collection points, making the water safe enough to reduce the need to boil. This was then recognised as a carbon emission reduction program and monetised to help finance the maintenance of dispensers and refilling them with chlorine.

As such, they have succeeded in obtaining carbon credits. Evidence Action has now managed to secure carbon credits for its dispensers in Uganda, Kenya and for TCF-funded dispensers in Malawi. The aim is to expand the program to reach an additional 1 million people. While carbon credits provide an important revenue source, it has become clear this alone will not make the program self-sustaining. The revenue from the sale of 720,000 carbon credits accounted for 39 per cent of Dispensers for Safe Water's budget, with a service-for-fee approach covering the remaining costs of the project.

Sustainable Water Sourcing Through Engineered Wetlands

A community-based initiative in the Chinese villages of Xiadong and Lixi in the Dongjiang River Basin developed a project with Conservation International funding to make their water system more sustainable. The communities constructed a water treatment system that mimics wetlands[4].

These engineered wetlands facilitate the flow of contaminated water through traditional infrastructure such as shallow septic tanks, and into natural ecosystems such as marshes, plants and soil that absorb pollutants and filter water. The engineered wetlands in the two villages treat on average up to 9,000 tons of sewage annually, before the water returns to the river.

This project creates freshwater infrastructure while providing habitat for local frog, fish, insect, waterfowl and other species. The wetland is maintained by local villagers, who also take part in testing water quality, cleaning leaves and branches, and patrolling along the river.

This brings economic benefits to the local community, providing water stability which fosters economic growth. The watershed has also created an increase in tourism, stimulating the domestic economy. As part of the program, Conservation International helped train a group of villagers as guides to showcase the wetlands, and offered educational tours of the apiaries where beekeepers harvest honey, native herb and bamboo forests, and orange orchards. A portion of the revenue from the tours goes to a community water fund, which was set up to support the wetlands' maintenance.

The success of this program has caused Conservation International and partners to expand the program to other areas through the '100 Village Initiative,' which aims to improve freshwater health in 100 villages along the Dongjiang River. This project will be transformative for the Dongjiang River system, which provides drinking water for 40 million people, and can serve as an example for other communities looking to make their water systems more sustainable through a program led by the local community for the local community.[5,6,7]

BUILDING RESILIENT FOOD SYSTEMS

Farmer Managed Natural Regeneration (FMNR)

Farmer Managed Natural Regeneration (FMNR) is a low-cost land restoration technique developed by Tony Rinaudo from World Vision. Rinaudo pioneered FMNR in Niger during the 1983 famine and is regarded as the leading expert in the technique worldwide. FMNR promotes water harvesting techniques as the planting includes a micro-catchment which traps surface run-off, makes the soil and water settle down, and feeds the plant at a microsite.[8]

In practice, FMNR involves the systematic regrowth and management of trees and shrubs from felled tree stumps, sprouting root systems or seeds. This process is low-cost because participants look to re-sprout tree stumps, undertake rootstock or recruit seeds that are present in the soil or are dispersed into the field. The farmers prune, mulch and engage in active protection. The regrown trees and shrubs help restore soil structure and fertility, inhibit erosion and soil moisture evaporation, rehabilitate springs and water tables, and increase biodiversity. Some tree species also impart nutrients such as nitrogen into the soil.[9]

Since the early 1990s, Southern Niger has perhaps experienced the most rapid, farmer-managed re-greening in human history. Over seven million hectares of mosaic parkland have been restored through the regrowth of 'underground' trees.[10] Niger is now greener than northern Nigeria – although it has less rainfall.

The success of the World Vision project in Humbo, Ethiopia has led to the Government of Ethiopia calling for a 15-million-hectare scale-up. The Global Ever Greening Alliance is now promoting the FMNR and related re-generation mechanisms across the Sahel and drylands in other parts of the world. TCF is implementing an FMNR project among pastoralists in Longido in Northern Tanzania to complement the land use planning and pasture regeneration projects it has been running there. A 2018 World Bank study investigating crop modelling, FMNR and drought impact reduction found that when native species are added to other productivity-enhancing technologies, the projected number of poor, drought-affected people living in drylands by 2030 falls by 13 per cent with low-density tree systems and by more than 50 per cent with high-density tree systems.[11]

Farmer-managed natural regeneration programs look to improve a community's agro-ecological conditions by reversing the environmental damage that occurs when trees are lost, either due to natural causes or human behaviour. By restoring vegetation and trees these programs reduce fuelwood scarcity, increase building materials and forage for animals, which are essential to sustain the ecosystem.

The regeneration has specific benefits to particular members, such as women and girls tasked with searching for and collecting fuelwood, cooking food and gathering wild fruits. Additionally, as FMNR looks to reverse wood scarcity and improve the general environment, it can aid in reducing tensions and conflict by eliminating the need to fight over resources. This development could be significant, as the Global Terrorism Index highlighted, because violent extremists look to capitalise and exploit environmental harm, poverty and hardship in their recruitment drives.

FMNR could help limit and prevent resource-driven conflict by promoting more robust land use and land access rights (including preventing and reversing land erosion). By doing so, FMNR aids local communities to move away from subsistence farming and facilitates income generation. In Humbo, Ethiopia, it is estimated that some $160,000 of fuelwood will be harvested from the project. This is in addition to creating both temporary and permanent employment.

By regenerating trees and ensuring community recognition that these finite resources require protection and nourishment, communities gain a sustainable fuelwood supply. This helps reduce insecurity, as women and girls need not venture too far from the community to find fuel. FMNR also involves the protection of fragile water catchment areas and the restoration of water, which is key as many places in sub-Saharan Africa face water stress and scarcity.

FMNR could play an important role in promoting adaption policies across Africa, where droughts are becoming more frequent and millions must deal with water shortages. African countries must invest more in adaption policies, something that many middle-and-high-income countries are already doing. However, many low-income countries are unable to, as adaption policies require enormous investment and infrastructure restructuring, because existing structures are only suitable for an environment that no longer exists.

Improving Food Yields in Kisii, Kenya

The absence of volcanic rejuvenation, cycles of weathering, erosion and leaching on the continent over the years has left soil in sub-Saharan Africa inherently low in nutrients. This has also resulted in a wide diversity of soil types that differ dramatically in their ability to retain and supply nutrients to plants, hold or drain water, withstand erosion or compaction, and allow root penetration.

One project funded by TCF and implemented by One Acre Fund (OAF) in Kisii in Western Kenya focuses on crop yields. The model is simple and provides high quality seeds and fertiliser on credit, along with high quality extension advice on planting, weeding and harvesting. After harvest, the farmers are assisted to market their produce. With the realised yield and productivity increase, the farmers are able to repay the input and training received, while earning a higher profit than before. The seed and fertiliser bank is maintained by a cooperative.

One Acre Fund now serves more than a million farmers in the Sahel who now earn higher profits.

Food Security Through Sustainable Aquaculture

By implementing programs that support sustainable aquafarming practices, smallholder farmers can increase their efficiency and production all while reducing their ecological impact. Currently, half of all seafood consumed is farmed and one-third of the world's wild fisheries are depleted because of overfishing, pollution and the effects of long-term temperature changes. Populations of fish like cod and salmon are decreasing, as they are being fished faster than they can reproduce. It is projected that aquaculture production must double by 2050 to meet growing demand.[12] When smallholder aquafarmers attempt to meet growing demand by participating in deforestation and destruction of wetlands, food systems are compromised. Unsustainably sourced fish feed depletes species that local communities rely on in the aquafarming sector.

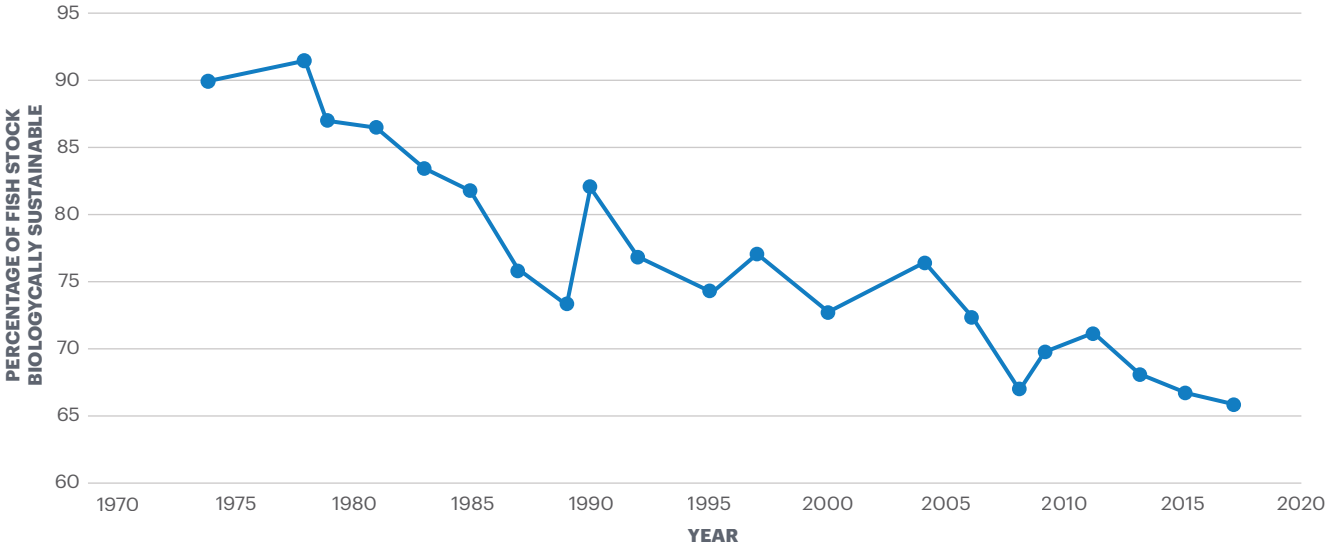
While there can be massive ecological impacts from unsustainable fishing practices, they are also practices that increase production without coming at the expense of environmental degradation.[13,14,15]

Sustainable aquaculture practices increase efficiency and while there is an upfront cost, the payoff is substantial. Sustainable fish food is more cost effective with a much lower cost over time. Making aquaculture more sustainable includes practices like avoiding deforestation, filtering the water on aquafarms before releasing it into surrounding ecosystems, limiting the use of antibiotics, investing in disease management, using low impact fish feed, selective breeding, and more.

FIGURE 5.3

Percentages of stocks fished at biologically sustainable levels, 1974–2017

Sustainable fish stocks have decreased by 24 percentage points since 1975.



Source: FAO

Hyperlocal Tropical Weather Forecasting

Designed with the goal of providing farmers in tropical areas with a tool to increase the efficiency of their farm, Ignitia works with development agencies, NGOs, agri-input businesses and other global industries that are affected by weather variability in the tropics to deliver SMS text messages to local farmers with reliable weather predictions.

Storms in tropical areas are characteristically smaller than in non-tropical regions with a quick onset, which makes general weather predictions insufficient for tropical areas. Global models in the tropics are correct only about 39 per cent of the time.[16] By developing a weather prediction system specifically designed to predict tropical weather patterns on a hyperlocal level, Ignitia is able to deliver forecasts to West African farmers in partnership with mobile network operators to truly help farmers anticipate weather.

Weather patterns in the region are becoming increasingly erratic and unpredictable, so farmers benefit greatly from having a tool to help them adapt their farming practices to anticipated weather. In the tropics within Africa, 96 per cent of the agriculture is rain-fed, meaning that weather prediction has a largely positive impact on their ability to farm productively. Most farmers in Africa have access to a phone and the SMS text format is designed to be inclusive to areas with low-literacy rates.

Farmers using the service only pay a few cents per day, less than two per cent of their annual input costs. Ignitia is partnering with larger agencies, such as UNDP, to provide free access to certain vulnerable communities.[17] The pilot test in Northern Nigeria with 2SCALE was successful and saw 1,400 farmers benefitting from the project. These farmers saw an improvement in their yield compared to the previous season, and 90 per cent reported they were satisfied or very satisfied with the Iska weather forecasts. Meanwhile 88 per cent reported that they used the weather forecasts to improve their farming practices leading to a yield increase.[18]

RURAL DEVELOPMENT

The programs with the most impact in building resilient communities and sustainable food systems, provide farmers with tools that reduce obstacles faced by local farming communities. Smallholder farmers supply food for 70 per cent of the developing world. Rising populations, low crop yields, inadequate infrastructure and lack of access to formal finance are just a few of the obstacles smallholder farmers face. By reducing these obstacles, local farms can increase their productivity while promoting sustainable agricultural practices.

In the interest of sustainable development and to help alleviate the obstacles faced, investment should focus on smallholder farmers. Many programs showcase the ability of private enterprise to play a positive role in building resilience as shown by the following four program examples.[19]

The Coffee Farmer Resilience Initiative (CFRI)

The CFRI's objective was to help farmer resilience. In this program, coffee companies supported smallholder farmers to address the spread of a disease that affects coffee crops by providing technical assistance on rehabilitation, renovation and climate-smart agricultural practices.[20] The CFRI was funded through the Coffee Farmer Resilience Fund, a financing mechanism.

Impact Terra's Golden Paddy Digital Platform

This program facilitated access to the finance sector for smallholder farmers in Myanmar, where the lack of access to finance hampers smallholder productivity. Thanks to the access to mobile phones in these rural areas, digital service providers have the opportunity to cost-effectively connect small holders with local financial institutions and agricultural service providers. Nearly two-thirds of Myanmar's population work in the agricultural sector, and despite high poverty rates 70 per cent of smallholder farmers have mobile phone access.[21] This platform was designed to increase farmers' crop productivity by providing real-time, tailored agronomic advice, weather and pest alerts, better market connections and access to improved financial opportunities. This project focuses on financial inclusion, with an objective to deliver scalable farming advice and contribute to the financial inclusion of smallholder farmers.[22]

Large-scale data analytics and crop prediction models are just two of the tools used to assist in delivering tailored advice to rural customers and service providers. This program offers financial inclusion through both a free mobile application (the Golden Paddy App) and a free web application. The mobile application provides tailored agronomic support services to smallholder farmers; with the advice primarily aimed at helping farmers increase their productivity in line with Good Agricultural Practices (GAP). The web application offers business-to-business support to financial institutions, traders and agricultural enterprises.

Beekeeping and Big Cats: Supporting Conservation and Rural Development

Creating beehives in both Tanzania and China have proven to be a cost-effective and simple way to build food resilience, create an opportunity for rural development, provide income for community members, increase native crop production and preserve resources (like sustainable forests). In areas with poor economic conditions but access to natural resources, communities often contribute to logging, deforestation and unsustainable hunting practices. Around 90 per cent of the world's food supply comes from about 100 crop species, and 71 of those crops rely on bees for pollination.[23] Beekeeping is a source of goods like honey and raw materials for various industries like beeswax candles. It is also an important income generating activity, with high potential for improving incomes, especially for communities living close to forests and woodlands. Beekeeping improves biodiversity and increases crop production, causing native plant species to flourish.[24]

An initiative led by Tanzanian women beekeepers is aiding vital conservation, rural economic development, environmental sustainability and financial literacy by strategically planting beehives in trees. Under Tanzanian law, trees holding beehives cannot be cut down and by planting beehives in certain trees, critical rangelands are protected. This preserves resources and fosters the habitat for many endangered species like lions, leopards and cheetahs. The honeybees regenerate degraded pastures and are vital for the health of native plant species. The honey produced has generated a sustainable revenue stream for rural women, aiding in rural economic development.[25]

The initiative has placed more than 1,350 environmentally friendly beehives and hosted more than 50 million bees.[26] Currently, the Women's Beekeeping Initiative has helped to protect an estimated 439,847 acres of vital rangelands. This provides habitat for lions, leopards and cheetahs which are all classified as 'Vulnerable' on the IUCN Red List of Threatened Species. One of the biggest threats these big cats face is loss of rangeland habitat. As a result of this program, an increase of big cats has been observed in the Tarangire-Manyara ecosystem.[27]

Tanzania People & Wildlife bolsters the ecological benefits from this program, by layering beehives from the Women's Beekeeping Initiative with its human-wildlife conflict and sustainable rangeland initiatives.

In a similar project, the World Wildlife Fund (WWF) donated 400 beehives to community residents in the continental tiger range in Huangnihe National Nature Reserve and provided technical training on beekeeping. Investment in beekeeping supported the production of honey and raw materials, which aided in economic rural development. Just as the Tanzanian beekeeping initiative has provided safe sustainable habitats for endangered lions, cheetahs and leopards, this project provides sustainable forests for the endangered tiger population in China. The increase in crop production, ability to hunt sustainably and improved income shows the success of this program.

Development of Cooperatives & Small Businesses

A cooperative in Kangalumira, Uganda was developed to upgrade its value-added processes and equipment. This assists the farmers to gain a higher income from their small-scale farms and has developed into a revolving fund approach. These funds are leveraged into other cooperatives to develop value-added products for their crops.

In Kangalumira, 3,250 farmers from 28 farmer groups associated with the cooperative were supported with training on pineapple growing and collective marketing. The cooperative was assisted with equipment like solar driers, to produce pineapple chips and juice, and wine processing equipment. This equipment allowed the members to add value through the cooperative to the pineapples, that had until then been exclusively sold fresh.

The cooperative and its member farmers paid 10 per cent of the equipment cost upfront and paid back the remaining 90 per cent over three years at 2.5 per cent interest per month to a revolving fund established by CESA-Uganda.

The returned funding was then reinvested in a similar project in Nazigo, where a maize and rice mill and processing facility was established as a cooperative. This allowed 450 farmers and their families to realise higher profits from communally owned, value-addition facilities. They received training on the production and marketing of the produce, and were given ongoing management support and a loan towards the equipment. Farmers were obliged to pay back their loan into the revolving fund.

A TCF project in Buusana will install a tomato processing unit. This will include a cooler and the ability to produce juice, puree, paste, ketchup, sauce and canned whole products. The project will train 1,000 farmers in tomato processing (post-harvesting storage, grading and packing) and the construction of water-harvesting technologies. The farmers will repay the money into the revolving fund.

Appendices

APPENDIX A

The ETR Indicator Sources, Definitions & Scoring Criteria

The information below details the sources, definitions, and scoring criteria of the four indicators that form the Ecological Threat Report. All scores for each indicator are banded or normalised on a scale of 1-5, whereby qualitative indicators are banded into five groupings from very low to severe.
The overall score for any given ADMIN1 is the **maximum of any of the indicators in the ETR.** Country level indicators scores are the population weighted average of all subnational scores. The overall score for a country is the maximum country indicator score.

Natural Disaster Displacement

Indicator type	Quantitative
Data Sources	The Geocoded Disasters (GDIS) Dataset/ EMDAT
Measurement period	2000–2019

Definition: The combined likelihood of an event in any given year and the proportion of those events that affected more than 5% of people.

Calculation: The annual frequency and median severity of Drought, Earthquakes, Volcanic activity, Mass movements, Storms, Floods and Wildfires are used to calculate the likelihood of an event in any given year, multiplied by the proportion of those that affect more than 5 per cent of the population. These values are normalised on a scale of 1 to 5.

Scoring Bands:

Indicators	1 (Very Low)	2 (Low)	3 (Medium)	4 (High)	5 (Severe)
Chance of Serious Natural Disasters	0-1.42%	1.42-2.9%	2.9-4.36%	4.36-8.6%	>8.6%

Demographic Pressure

Indicator type	Quantitative
Data Sources	Gao, J. 2020. Global 1-km Downscaled Population Base Year and Projection Grids Based on the Shared Socioeconomic Pathways, Socioeconomic Data and Applications Center (SEDAC).
Measurement period	2020 and 2050
Additional note	Future projections based on IPCC fifth assessment report. The future projections used are the Shared Economic Pathway 3 7.0. This is considered the middle of the range of baseline outcomes.

Definition: The percentage difference between the 2020 population and the 2050 population for each admin.

Calculation: The population data is available at a 1 kilometre grid spatial resolution level. The total population of each ADMIN1 is aggregated for both 2020 and 2050. The percentage difference between the future and current population is calculated as the population growth variable. A positive value indicates that the projected population is higher than the current population.

The population growth variable is then normalised on a scale of 1 to 5 to determine the overall population growth score indicator.

Scoring Bands:

Indicators	1 (Very Low)	2 (Low)	3 (Medium)	4 (High)	5 (Severe)
Population Growth	<20%	20%–30%	30%–50%	50%–70%	>70%

Food Insecurity

Indicator type	Quantitative
Data Sources	• Proteus Food Security Index, • Subnational HDI UNDP: › Prevalence of Stunting › Prevalence of Undernourishment › Income • Gallup World Poll-In the Past 12 Months Have you Not Been able to Buy Food for you Family", • EIU Food Security Index • Famine Early Warning Systems Network
Measurement period	2022

Calculation: Subnational units are assigned the EIU national score scaled subnationally by available data on famine, undernourishment and stunting. Imputations are based on the World Food Program Hunger Map. The Food Security domain is calculated from the above sources using an xgbBoost machine learning approach.

Scoring Bands:

Indicators	1 (Very Low)	2 (Low)	3 (Medium)	4 (High)	5 (Severe)
Food Insecurity	<20% of countries	20%–40% of countries	40%–50% of countries	50%–65% of countries	>65% of countries

Water Risk	
Indicator type	Quantitative
Data Sources	World Resources Institute (WRI)
Measurement period	Current Baseline Estimate
Additional note	Future projections based on IPCC fifth assessment report. The future projections used are the Shared Economic Pathway 3 7.0. This is considered the middle of the range of baseline outcomes produced by energy system models. The model used is GFDL-ESM4 developed by the National Oceanic and Atmospheric Administration (NOAA).

Definition: Water Risk is defined by percentage of population without access to clean drinking water. IEP bands the WRI categories to a scale of 1 to 5.

Scoring Bands:

Indicators	1 (Very Low)	2 (Low)	3 (Medium)	4 (High)	5 (Severe)
Water Stress Score ADMIN1 Average	<0.1	0.1–0.9	0.9–1.9	1.9–2.9	>2.9

APPENDIX B

ETR Domain Scores

Country	Overall Score	Food Insecurity	Natural Disasters	Demographic Pressure	Water Risk
Afghanistan	5	5	2.75	4.28	5
Albania	3	3	2.15	1	2.77
Algeria	2.5	2	1.2	2.5	1.38
American Samoa	3	3	2.83	1	3
Andorra	1	1	1	1	1
Angola	5	5	2.97	5	5
Anguilla	3	3	1	1	3
Antigua and Barbuda	3.28	3	3.28	1	3
Argentina	1.98	1.98	1.71	1.62	1.13
Armenia	3.23	2.6	3.23	1	1.97
Australia	3.08	1	3.08	2.63	1
Austria	1	1	1	1	1
Azerbaijan	4.15	2.64	1.8	1	4.15
Bahamas	3	3	1.08	1	2.93
Bahrain	3	1	1	3	2.76
Bangladesh	5	4.06	5	1.24	1.86
Barbados	3	2	1.14	1	3
Belarus	1.47	1	1	1	1.47
Belgium	1	1	1	1	1
Belize	3.89	3	3.89	3.28	3.84
Benin	5	5	3.63	5	5
Bermuda	3	3	1	1	3
Bhutan	3.2	3.2	1.15	1.87	2.97
Bolivia	4.95	4.32	3.36	2.59	4.95
Bonaire, Sint Eustatius and Saba	3	3	1	1	1.47
Bosnia and Herzegovina	3.96	2	3.96	1	1
Botswana	4.19	4.19	2.8	2.99	3.75
Brazil	3.94	2.89	2.05	1	3.94
British Virgin Islands	3	3	1	1	3
Brunei	2.2	2	1	1.63	2.2
Bulgaria	2.02	2.02	1	1	1
Burkina Faso	5	4.82	2.7	5	5
Burundi	5	5	2.79	5	5
Cabo Verde	5	4	1.79	2.62	5
Cambodia	5	5	4.6	2.72	4.94
Cameroon	5	4.74	1.24	5	5
Canada	1.44	1	1	1.44	1.02
Cayman Islands	3	3	1	2	3
Central African Republic	5	5	1.79	4.99	5
Chad	5	5	3.55	5	4.93
Chile	2.83	2.03	2.83	1	1.06
China	4.23	2	4.23	1.01	3
Colombia	4.08	3.93	2.88	1	4.08
Comoros	5	5	4.68	4.68	4.95
Cook Islands	3	3	1	1	3
Costa Rica	3	3	1.76	1	1.6
Côte d'Ivoire	5	4	1	5	5
Croatia	1.17	1.02	1.17	1	1

Country	Overall Score	Food Insecurity	Natural Disasters	Demographic Pressure	Water Risk
Cuba	4.47	3.03	4.47	1	3.05
Cyprus	1	1	1	1	1
Czechia	2.58	1	2.58	1	1.06
Democratic Republic of the Congo	5	5	1.13	5	5
Denmark	1	1	1	1	1
Djibouti	5	4	3.93	2.57	5
Dominica	4	4	3.6	1	3
Dominican Republic	4.99	3.31	1.7	1.36	4.99
Ecuador	4.6	4	1.56	2.73	4.6
Egypt	3.23	2.04	1	3.23	1.03
El Salvador	4	4	3.66	1	4
Equatorial Guinea	5	4	1	5	5
Eritrea	5	5	2.3	4.62	5
Estonia	1.22	1	1	1	1.22
Eswatini	5	5	5	3	5
Ethiopia	5	5	4.66	4.67	5
Faroe Islands	1	1	1	1	1
Fiji	4.99	3	4.99	1	4.96
Finland	1.41	1	1	1	1.41
France	1.13	1	1.13	1	1
French Guiana	5	3	1	5	2.23
French Polynesia	3	3	1	1.05	3
Gabon	5	4.15	2.08	4	5
Gambia	5	4.76	3.43	5	5
Georgia	3.47	3.47	2.91	1	1.98
Germany	1	1	1	1	1
Ghana	4.85	4	2.27	4.03	4.85
Greece	1.4	1	1.4	1	1.07
Greenland	1	1	1		1
Grenada	3	3	1.43	1	1.05
Guadeloupe	3	3	1	1	3
Guam	3	3	1.8	1	3
Guatemala	4	4	3.09	3.58	3.96
Guinea	5	5	1.33	5	5
Guinea-Bissau	5	5	3.07	4.99	5
Guyana	3.9	3	3.9	1	3.02
Haiti	5	5	4.23	2.27	4.92
Honduras	4.33	4	3.75	2.93	4.33
Hungary	1.24	1	1.24	1	1
Iceland	1	1	1	1	1
India	4.05	4.05	3.73	1.52	3.91
Indonesia	4.51	3.01	1.32	1.24	4.51
Iran	3.33	2.84	1.72	1	3.33
Iraq	5	3.84	1.37	5	3.81
Ireland	1.27	1	1	1.27	1
Isle of Man	1	1	1	1	1
Israel	3.18	1	2.97	3.18	1.71
Italy	1.3	1	1.3	1	1
Jamaica	3.97	3	2.67	1	3.97
Japan	1.12	1	1.12	1	1
Jordan	3	3	1.02	3	1.88
Kazakhstan	3.24	1.17	1.03	1.51	3.24
Kenya	5	5	3.2	4.94	5
Kosovo	1	1	1		1
Kuwait	2.66	1	1	2.66	1.11

Country	Overall Score	Food Insecurity	Natural Disasters	Demographic Pressure	Water Risk
Kyrgyzstan	3.73	3	2.68	1.64	3.73
Laos	4.79	4.28	4.06	2.32	4.79
Latvia	1.9	1	1	1	1.9
Lebanon	3	3	1.6	1	1
Lesotho	5	5	4.23	3	4.95
Liberia	5	5	1	5	5
Libya	3	3	1.01	1.91	2.85
Liechtenstein	1	1	1	1	1
Lithuania	2.74	1.33	1	1	2.74
Luxembourg	2.62	1	1	2.62	1
Madagascar	5	5	3.27	5	5
Malawi	5	5	4.19	5	5
Malaysia	2.54	1.93	2.01	1.87	2.54
Mali	5	4.67	3.21	5	4.93
Malta	1	1	1	1	1
Marshall Islands	3	3	1.16	1.88	3
Martinique	3	3	1	1	3
Mauritania	5	4.1	3.83	5	4.47
Mauritius	5	2	2.31	1	5
Mayotte	5	5	1	5	5
Mexico	3	3	1.91	1.6	2.32
Micronesia	3	3	1	1.39	3
Moldova	3.71	3	2.18	1	3.71
Mongolia	4.84	4	2.64	2.01	4.84
Montenegro	1.25	1.25	1	1	1
Montserrat	3	3	1	1	3
Morocco	4.71	3	1.1	1.51	4.71
Mozambique	5	5	4.19	5	5
Myanmar	5	4.14	1.48	1.14	5
Namibia	5	5	4.32	4	5
Nauru	3	3	1	1	3
Nepal	4.91	4.91	2.76	1.24	4.09
Netherlands	1	1	1	1	1
New Caledonia	3	3	1	2.48	1.23
New Zealand	1.47	1	1.47	1.13	1
Nicaragua	5	4.08	3.48	1.5	5
Niger	5	5	5	5	4.92
Nigeria	5	4.97	2.46	4.95	5
North Korea	5	5	4.51	1	1.02
North Macedonia	2.92	2.92	2.69	1	1.03
Northern Mariana Islands	3	3	1	1	1.09
Norway	1.87	1	1	1.87	1
Oman	2.53	2	1	2.53	1
Pakistan	4.08	4.08	3.16	3.51	4
Palau	3	3	1	2.41	3
Palestine	5	3	1.35	5	3
Panama	4.15	3	1.47	2.95	4.15
Papua New Guinea	5	5	2.05	3.98	4.95
Paraguay	4	4	3.35	1.93	1.66
Peru	5	4	1.89	1.75	5
Philippines	4.5	4	4.5	2.95	4.01
Poland	2.55	1	1	1	2.55
Portugal	1.02	1	1.02	1	1
Puerto Rico	2	2	1.31	1	1.22
Qatar	3	1	1	3	1

Country	Overall Score	Food Insecurity	Natural Disasters	Demographic Pressure	Water Risk
Republic of the Congo	5	5	1.86	5	5
Réunion	5	5	1	1	5
Romania	1.96	1.96	1.11	1	1.08
Russia	2.94	2	1.22	1	2.94
Rwanda	5	5	3.2	4.48	5
Saint Helena, Ascension and Tristan da Cunha	5	5	1.02	1	5
Saint Kitts and Nevis	3	3	1.49	1	3
Saint Lucia	4.21	3	4.21	1	3
Saint Pierre and Miquelon	2	1	1	1	2
Saint Vincent and the Grenadines	4	3	4	1	1.08
Samoa	3.49	3	3.49	1.72	3
San Marino	1	1	1	1	1
São Tomé and Príncipe	5	5	4.74	5	5
Saudi Arabia	2.5	2	1	2.5	1.31
Senegal	5	4	2.39	5	4.82
Serbia	2.33	2.33	1.09	1	1
Seychelles	5	3	3.4	1	5
Sierra Leone	5	5	1.4	4	5
Singapore	1	1	1	1	1
Slovakia	1.15	1	1	1	1.15
Slovenia	1	1	1	1	1
Solomon Islands	4.53	4	3.66	4.15	4.53
Somalia	5	5	4.54	5	5
South Africa	3.83	3.83	2.68	1.88	3.73
South Korea	1.03	1	1.03	1	1
South Sudan	5	5	4.55	5	5
Spain	1.28	1	1.28	1	1
Sri Lanka	4.88	4	4.88	1	3.97
Sudan	5	5	3.45	5	4.82
Suriname	3.92	3	2.02	1	3.92
Sweden	1	1	1	1	1
Switzerland	1	1	1	1	1
Syria	5	3.68	2.57	5	1.22
Taiwan	3	3	1.7	1	1
Tajikistan	5	4	4.3	3.73	5
Tanzania	5	5	1.97	5	5
Thailand	4.6	3	4.6	1	1.41
Timor-Leste	4.96	4.94	3.59	4.85	4.96
Togo	5	5	1.24	5	5
Tokelau	5	3	3.58	5	3
Tonga	4.09	3	4.09	1.65	3
Trinidad and Tobago	2.88	2.88	2.19	1	1.27
Tunisia	2.56	2	1	1.05	2.56
Türkiye	1.96	1.96	1.61	1	1.04
Turkmenistan	2.52	2	1	2.52	1.66
Turks and Caicos Islands	3	3	1.84	2.52	1.15
Tuvalu	3.14	3	3.14	2.84	3
Uganda	5	5	1.54	4.97	5
Ukraine	2.28	2.28	1.25	1	1.29
United Arab Emirates	3	1	1	3	1.03
United Kingdom	1	1	1	1	1
United States	1.95	1	1.66	1.22	1.95
Uruguay	2.75	2	2.75	1	1.11
Uzbekistan	2.42	2.42	1.24	1.33	2.1

Country	Overall Score	Food Insecurity	Natural Disasters	Demographic Pressure	Water Risk
Vanuatu	4.97	4	4.97	4	3.43
Venezuela	4	4	1.52	2.31	3.96
Vietnam	3.77	3.14	3.65	1.09	3.77
Virgin Islands, U.S.	3	3	2.02	1	3
Wallis and Futuna	3	3	1	1	3
Western Sahara	5	5	1	4	1.9
Yemen	5	5	1.36	4.24	4.61
Zambia	5	5	4.07	5	5
Zimbabwe	5	5	3.26	3.69	5

Source: IEP

APPENDIX C

The following are the countries that exhibit both high natural disaster risk and lower resilience as measured by the Positive Peace Index.

Bangladesh
Benin
Bolivia
Bosnia and Herzegovina
Cambodia
Chad
China
Cuba
Djibouti
El Salvador
Ethiopia
Gambia
Guatemala
Guinea-Bissau
Guyana
Haiti
Honduras
India
Kenya
Laos
Lesotho
Madagascar
Malawi
Mali
Mauritania
Mozambique
Namibia
Nicaragua
Niger
North Korea
Pakistan
Paraguay
Philippines
Rwanda
Somalia
South Sudan
Sri Lanka
Sudan
Swaziland
Tajikistan
Timor-Leste
Vietnam
Zambia
Zimbabwe

Source: IEP

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