



**United Nations**  
Convention to Combat  
Desertification

# The Global Threat of Drying Lands:

Regional and global aridity  
trends and future projections

SCIENCE-POLICY BRIEF

# MOST OF THE WORLD'S LAND IS DRYING

Rising aridity—the growing, long-term loss of available, life-sustaining moisture by terrestrial climates—is threatening people and environments in almost every global region. Increasingly, aridity-related land degradation and water scarcity are contributing to food and water insecurity, poor soil fertility, losses in crop and plant productivity, biodiversity declines, ecosystem degradation, intense sand and dust storms, wildfires, poor health and large-scale human migration.

More than three-quarters of all land on Earth experienced a drier climate during the three decades leading up to 2020, compared to the previous 30-year period, and global drylands expanded by about 4.3 million km<sup>2</sup>—an area equal to half the size of the continent of Australia/Oceania—to cover 40.6 per cent of global lands (excluding Antarctica).

## Aridity versus drought

Highly arid regions are places in which a persistent, long-term climatic condition lacks available moisture to support most forms of life and atmospheric evaporative demand significantly exceeds rainfall. Drought, on the other hand, is an anomalous, shorter-term period of water shortage affecting ecosystems and people and often attributed to low precipitation, high temperatures, low air humidity and/or anomalies in wind. While drought is part of the natural climate variability and can occur in almost any climatic regime, aridity is a stable condition for which changes occur over extremely long-time scales under significant forcing. While the long-term impacts of widespread drying are often difficult to quantify, as many as two in every five people could be living in drylands and facing dire impacts from further aridification by the end of the century. Water scarcity—a term that refers to the gap between available freshwater supply and demand in a specified area—is often linked to aridity. However, water scarcity is always influenced by water management practices and is often exacerbated by the long-term overuse and misuse of water.

Much of aridity's recent rise can be attributed to human-caused climate change. If the world fails in efforts to curb greenhouse gas emissions into the future, another 3 per cent of the world's humid areas are projected to transform into drylands by the end of this century.

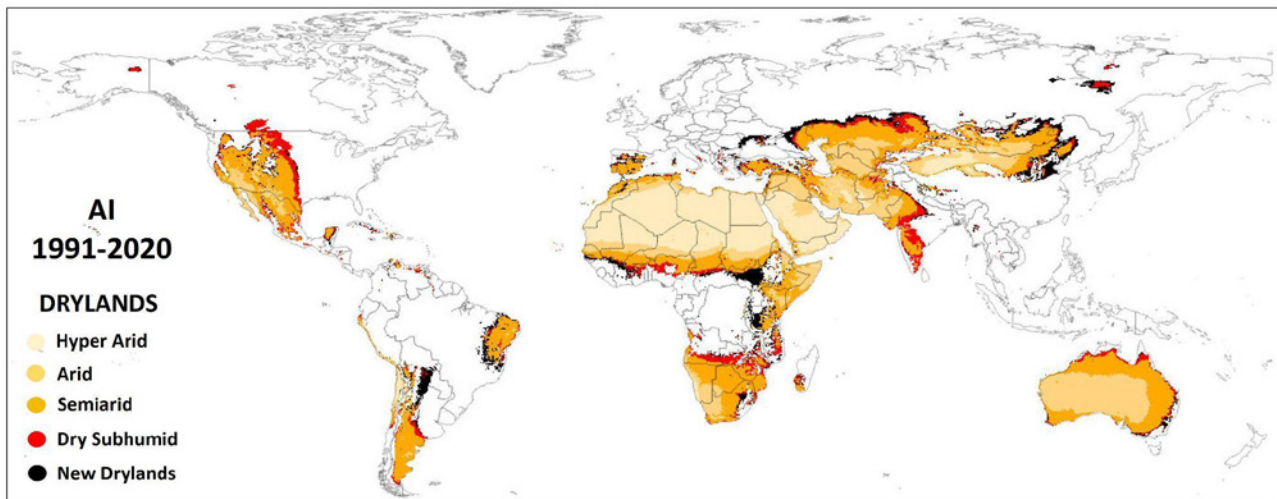
Meanwhile, people living in drylands have doubled in number—to 2.3 billion, more than a quarter of the global population—over the past three decades, and models suggest as many as 5 billion could inhabit drylands by 2100 in a worst-case climate change scenario.

Assessing and understanding aridity trends and future projections is critical to developing resilient adaptation and mitigation strategies. This brief and the accompanying report address the challenges in assessing aridity, aridity's current and future trends and the multifaceted impacts resulting from aridity, aiming to catalyse global, regional and local efforts towards sustainable adaptation measures.

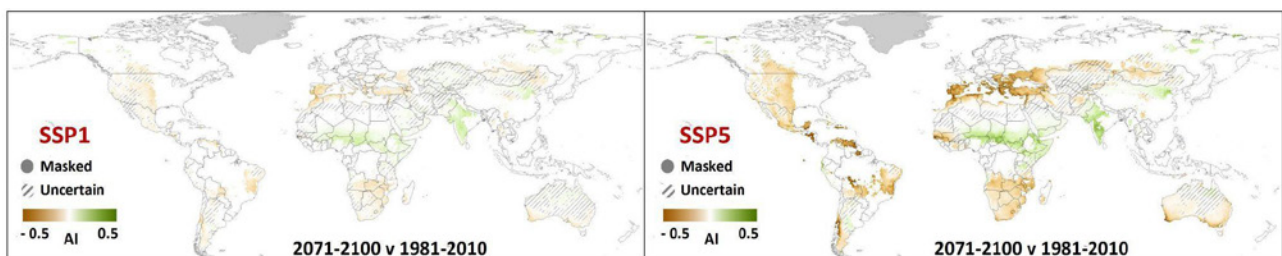
# DRYLAND EXPANSION IS AFFECTING LARGE REGIONS

Vast areas of the world show an increase in aridity in recent decades, in particular the western United States, Brazil, most of Europe, Asia (especially eastern Asia) and central Africa. Meanwhile, less than a quarter of global land (22.4 per cent) experienced a wetting tendency, including areas in central United States, the Atlantic coast of Angola and south-eastern Pacific Asia (i.e., Malaysia, Indonesia and the Philippines).

Aridity is expected to continue to rise in the climate-altered future. Climate projections for high emission scenarios show remarkable changes towards drier classes and even a shift from non-drylands to drylands in hotspots such as Midwestern United States, central Mexico, northern Venezuela, north-eastern Brazil, south-eastern Argentina, the entire Mediterranean region, the Black Sea coastal region, large parts of southern Africa and southern Australia (both the west and east coasts). No areas are projected to shift from being drylands in the past to humid in the future. Instead, increases in semi-arid and dry subhumid classes are expected for all regions.



**FIGURE 1** A global map of drylands in 1991-2020 (using the aridity index classification). New drylands are lands that shifted from humid in 1961-1990 to drylands in 1991-2020. Non-arid lands are masked.

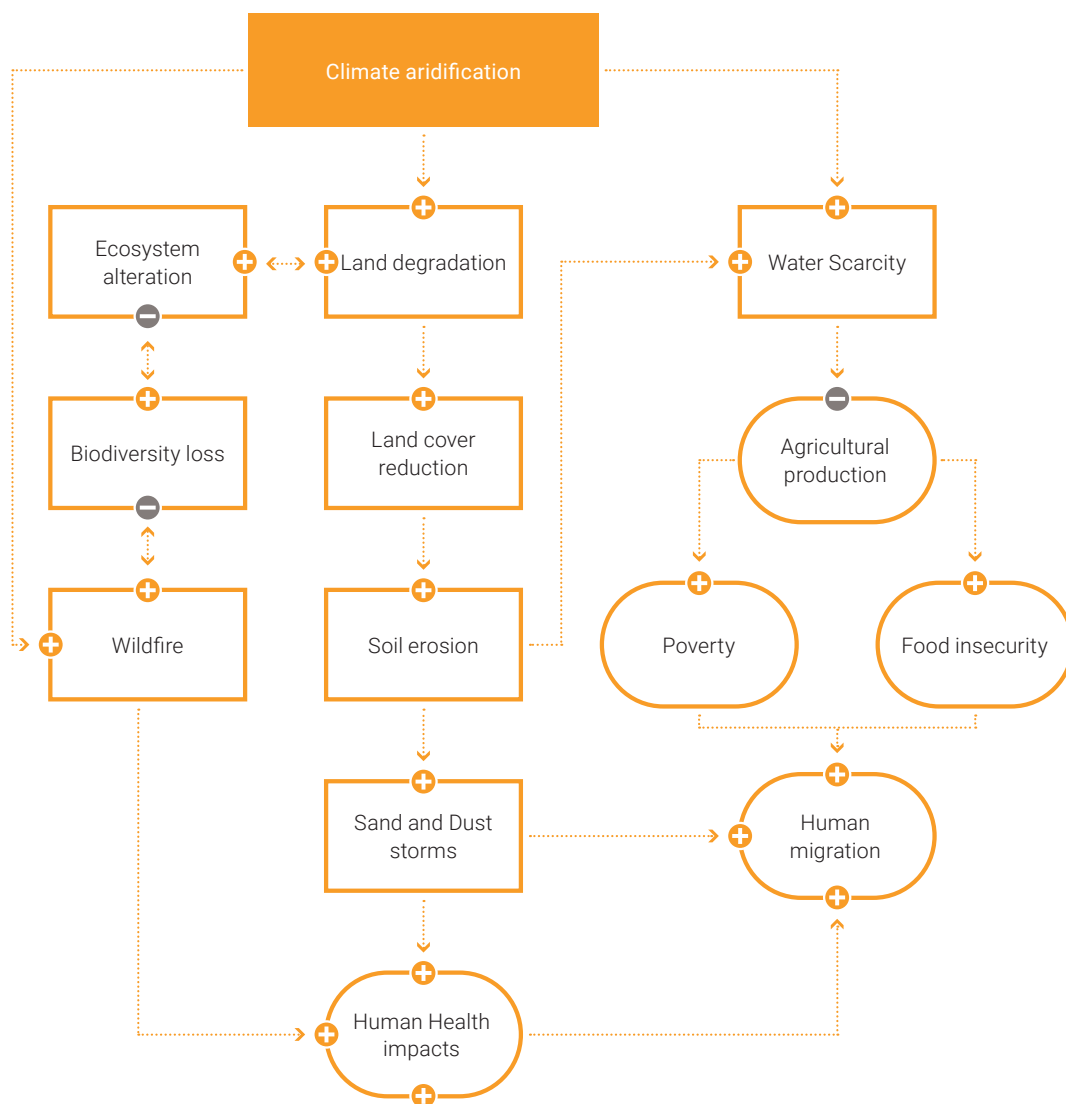


**FIGURE 2** Changes in aridity index values for drylands from 1981-2010 to 2071-2100, the SSP1-2.6 (left) and the SSP5-8.5 (right) emission scenarios.

## ARIDITY THREATENS PEOPLE, ECONOMIES AND ECOSYSTEMS

Climate aridification (i.e., rising aridity) has widespread consequences for multiple biophysical and socioeconomic systems, often in the form of cascading impacts involving complex interactions among these interconnected systems. Many of these impacts are already happening.

- **Desertification and land degradation:** Aridity is considered one of the world’s five most important causes of land degradation (along with land erosion, salinization, organic carbon loss and vegetation degradation).
- **Sand and dust storms:** Rising aridity in the Middle East has been linked to more frequent and larger sand and dust storms in the region.
- **Ecosystems and biodiversity:** More than a fifth of all land could experience abrupt ecosystem transformations in response to rising aridity by the end of the century, according to recent projections.
- **Wildfires:** Increasing aridity is expected to play a role in larger and more intense wildfires in the climate-altered future—not least because of its impacts on tree deaths in semi-arid forests and the consequent growing availability of dry biomass for burning.
- **Water scarcity:** More than two-thirds of all land on the planet (excluding Greenland and Antarctica) is projected to store less water by the end of the century, if greenhouse gas emissions continue to rise even modestly.
- **Farming and food production:** Aridity is considered the world’s largest single driver behind the degradation of agricultural systems, affecting 40 per cent of Earth’s arable lands.



- **Poverty:** Rising aridity has been blamed for a 12 per cent decline in gross domestic product (GDP) recorded for African countries between 1990–2015.
- **Human health:** Rising aridity’s impacts on poverty, water scarcity, land degradation and insufficient food production have been linked to increasing rates of sickness and death—especially among children and women around the world.
- **Human migration:** Rising aridity and drought play a key role in increasing human migration around the world—particularly in the hyperarid and arid areas of southern Europe, the Middle East and North Africa and southern Asia.

## HOW TO ADAPT TO RISING ARIDITY

Reducing the vulnerability of ecosystems and societies to increasing aridity requires both large-scale measures related to mitigating global climate change and more regional or local approaches tailored to vulnerable communities in arid regions. Understanding the interplay of atmospheric, oceanic and terrestrial factors is crucial to designing effective adaptation strategies. We identified the following key priorities to ensure adaptation to rising aridity:

### 1. Assessing vulnerabilities to aridity:

- **Prior land degradation:** Previous land or ecosystem degradation affects the vulnerability of land to impacts from aridity, increasing the risk of crossing key aridity thresholds that lead to dramatic, nonlinear changes to soils, vegetation and ecosystems. The degree of this vulnerability ranges from low (i.e., at risk of soil fertility loss) to high (i.e., at risk of overall land degradation). Unsustainable farming practices and rapid population growth exacerbate this vulnerability.

- **Poverty:** Economic limitations significantly increase vulnerability. Poor communities often lack resources to recover from climatic shocks, rely on climate-sensitive livelihoods and have limited access to adaptive knowledge and technologies.
- **Demography:** Population growth, overpopulation and sociodemographic factors, such as gender inequality and age, amplify vulnerabilities to aridity. Women and children, in particular, face increased risks due to limited access to resources and education.

## 2. Enabling conditions for adaptation to aridity:

- **Financial resources:** Adequate funding, including international aid and private sector investment, is critical for implementing effective adaptation measures.
- **Governance structures:** Robust governance is necessary for coordinated adaptation efforts involving multiple stakeholders and ensuring context-specific solutions.
- **Capacity building and education:** Enhancing local knowledge and skills through education and training fosters resilience. Awareness programmes and climate information services (CIS) are vital for informed decision-making.
- **Monitoring and reporting:** Regular assessments and transparent reporting of adaptation actions are essential for accountability and continuous improvement.

## 3. Adaptive strategies for aridity:

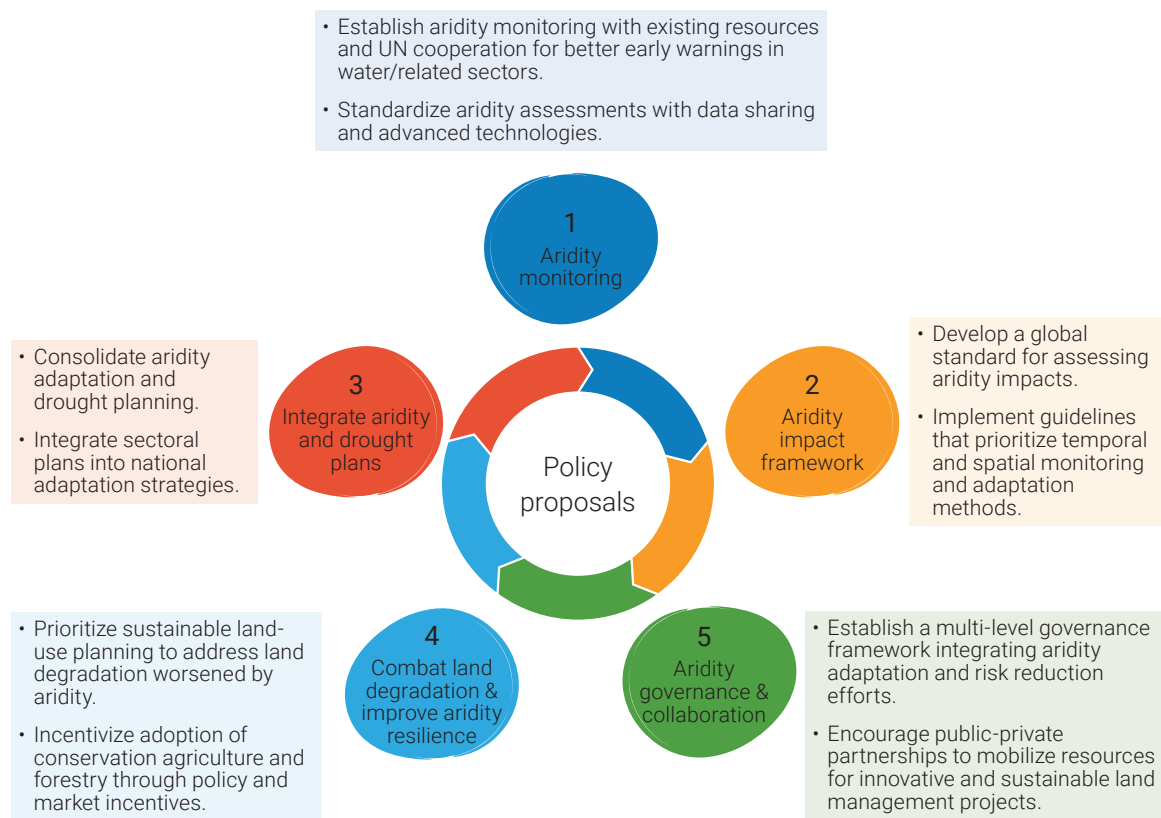
- **Transformational vs. incremental approaches:** Transformational adaptation approaches involve large-scale measures, such as afforestation programmes and the Great Green Wall initiative, that aim to transform ecosystems and enhance resilience. Incremental adaptation approaches, on the other hand, include practices like regreening degraded landscapes and implementing sustainable land management to progressively reduce vulnerability.
- **Sectoral adaptation approaches:** Adaptation to aridity requires approaches that consider particular sectors. Adaptation of the food production sector involves developing water-efficient crop varieties, sustainable irrigation practices and index-based insurance for farmers. Adaptation in the livestock management sector includes species diversification, such as switching to more arid-tolerant animals (e.g., goats, camels) and facilitating pastoral mobility. The adaptation of water management can include rainwater harvesting, drip irrigation and the reuse of greywater to manage scarce water resources in arid regions.

Adaptation to aridity requires a multifaceted approach, encompassing financial support, strong governance, capacity building and effective monitoring. Tailored regional strategies, combined with large-scale transformational actions, can enhance resilience to arid conditions. Further research on the socioeconomic impacts of aridity is imperative to develop comprehensive and informed adaptation policies.

# WHAT POLICYMAKERS CAN DO

The expansion of global drylands and the inadequacy of current policies related to water require new integrated, collaborative and adaptive approaches to address the complex challenges posed by aridity. Building on standardized assessments, inclusive governance and innovative solutions, the following policy-related actions should enhance resilience and sustainable practices in vulnerable regions and align with broader environmental and climate goals:

1. **Strengthen aridity monitoring and identify thresholds:** Aridity monitoring systems should be added into existing drought monitoring frameworks to identify and detect approaching critical ecological and socioeconomic thresholds. This integrated system can use existing drought observatories, as well as the UN Early Warning for All Initiative, to enhance global cooperation and early warning capabilities in water-related sectors. Globally standardized approaches for aridity assessments would enable timely responses to water stress conditions and foster collaboration through data sharing and the use of advanced technologies, such as artificial intelligence, for detection, prediction and risk evaluation.



- 2. Adopt a global-to-local aridity impact standard:** A global standard could provide uniform guidance for assessing the socioeconomic and environmental impacts of aridity, facilitate consistent analysis and cross-regional cooperation and enable (with appropriate support mechanisms) effective adaptation strategies among vulnerable communities. This globally uniform standard should incorporate indigenous knowledge and community-led efforts to ensure cultural sensitivity and local relevance.
- 3. Integrate aridity adaptation and drought planning into National Adaptation Plans:** The integration of aridity adaptation and drought planning into unified global, regional and local strategies is essential. Sectoral plans for aridity adaptation should be consolidated into national climate change adaptation strategies (i.e., National Adaptation Plans, or NAPs) that emphasize community involvement and foster sustainable water and land management practices. A robust framework for monitoring aridity-specific indicators is needed to ensure the efficiency and sustainability of adaptation efforts and to better align them with overarching climate adaptation strategies.
- 4. Implement comprehensive and integrative strategies to combat land degradation and enhance drought and aridity resilience:** Comprehensive and integrative strategies to combat land degradation and enhance resilience to aridity and drought should include promoting sustainable land-use practices, such as conservation agriculture and agroforestry, incentivized through appropriately tailored policy and market mechanisms. The integration of environmental, social and economic considerations into sustainable land-use planning could enhance ecosystem services and encourage soil and water conservation, especially if supported by emerging technologies and traditional knowledge.
- 5. Promote cross-sectoral aridity governance and collaboration through the UNCCD LDN mechanism:** Cross-sectoral governance to address aridity should be promoted through existing global mechanisms, such as the UNCCD land degradation neutrality (LDN) framework, and through local, regional, national and international collaboration. Strengthening a multilevel governance framework aligned with existing international agreements, predicated on international collaboration and public-private partnerships, can help to mobilize resources for innovative land management projects. Leveraging global funding mechanisms and promoting sustainable practices (such as integrated, multiscale and cross-sectoral strategies to monitor, mitigate and adapt to increased aridification) can contribute to advancing the best land-management practices and encouraging active participation in global initiatives.

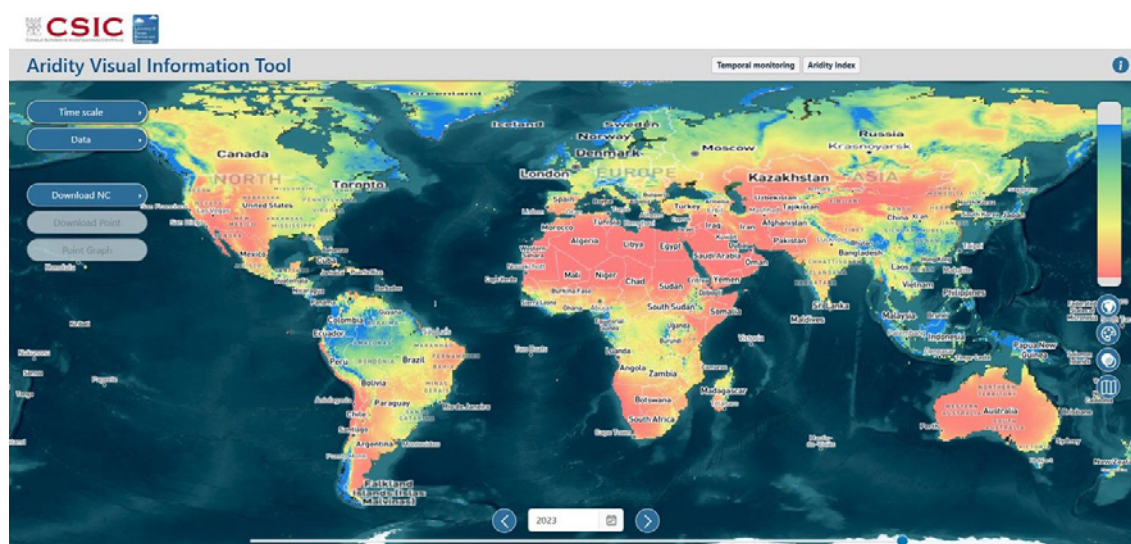
# THE ARIDITY VISUAL INFORMATION TOOL

Access to aridity information is essential for improving the capacity of governments and institutions to address aridity impacts and to develop better adaptation tools. The information generated for this report has been included in an Aridity Visual Information Tool, available at <https://global-aridity-monitoring-system.csic.es>.

This tool provides the global spatial distribution of the average aridity index and various aridity categories across two three-decade periods (1961-1990 and 1991-2020). It also includes aridity projections for 2100 based on two different emission scenarios (SSP1-2.6 based on sustainability and SSP5-8.5 based on fossil-fuel-driven global development) and highlights the uncertainties in these projections.

The tool provides a monitoring feature that updates the aridity index annually, using data from the past five years. This approach helps assess long-term changes in aridity by filtering out high-frequency climate variability, which is more closely related to drought events.

All data within the system can be downloaded in various gridded formats or as time series. The Aridity Visual Information Tool is also linked to the UNCCD Knowledge-Sharing Systems: <https://www.unccd.int/resources/knowledge-sharing-systems>. Information provided by the tool is highly relevant for assessing aridity at local-to-global scales and for informing socioeconomic and environmental aridity mitigation and adaptation efforts.



**FIGURE 3** The Aridity Visual Information Tool provides the global spatial distribution of the average aridity index and aridity categories for 1961–1990 and 1991–2020, as well as aridity projections to 2100 for two emission scenarios.

**Rising aridity—the growing, long-term loss of available, life-sustaining moisture by terrestrial climates—is threatening people and environments in almost every global region.**

Increasingly—as climate change causes drying across more than three-quarters of the world’s land—aridity-related land degradation and water scarcity are contributing to food and water insecurity, poor soil fertility, losses in crop and plant productivity, biodiversity declines, ecosystem degradation, intense sand and dust storms, wildfires, poor health and large-scale human migration.

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Download the corresponding  
Science-Policy Brief here:



Science-Policy Brief link here

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DESERTIFICATION**

Platz der Vereinten Nationen 1, 53113 Bonn, Germany  
Postal Address: PO Box 260129, 53153 Bonn, Germany  
Tel. +49 (0) 228 815 2800  
E-mail: [secretariat@unccd.int](mailto:secretariat@unccd.int)  
Website: [www.unccd.int](http://www.unccd.int)



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