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SCIENCE BEHIND THE NEWS

The United Nations Convention to Combat Desertification Report on Rising Aridity Trends Globally and Associated Biological and Agricultural Implications

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Aridity is an average long-term condition characterised by low precipitation and high atmospheric evaporative demand. Aridity significantly affects land degradation, desertification and the overall resilience of ecosystems—as a result, understanding aridity and its consequences for ecosystems and societies is critical in today's changing climate. Assessing aridity trends and future projections can help support the development of effective adaptation and mitigation strategies.

The Science Policy Interface (SPI) of the United Nations Convention to Combat Desertification (UNCCD) launched at the UNCCD COP16 (Riyadh, Saudi Arabia) a key report titled "The Global Threat of Drying Lands: Regional and global aridity trends and future projections" (Vicente-Serrano et al. 2024). Based on new analyses and an up-to-date literature review, this report represents the first comprehensive global assessment of aridity that includes (i) a thorough assessment of current and future trends and (ii) the multifaceted and often cascading impacts of aridity. The report considers effective and sustainable adaptation practices, together with recommendations for comprehensive monitoring and reporting frameworks, integrated sectoral plans, capacity-building programs and policy incentives linked to performance indicators.

The report outlines how drylands currently represent more than two-fifths (40.6%) of all land on Earth excluding Anctartica (Figure 1), including 9.1% of hyperarid, 10.5% of arid, 14.3% of semi-arid and 6.7% of subhumid lands. It also reveals that the drylands increased by more than 3% (from 37.5% to 40.6%, representing 4.3 million km^2) in recent decades (1991–2020), compared to the earlier period (1961–1990). Critically, the report quantified for the first time that most of the recent rise in aridity can be attributed to human-induced climate change, with a drying trend beginning in the 1950s and accelerating from the 1990s. If the world fails in efforts to curb greenhouse gas emissions in the future, another 3% of the world's humid areas are projected to transform into drylands by the end of this century.

The report then explores the ecological and agricultural implications of aridity and aridification processes. In addition to a range of associated negative impacts on ecosystems, aridity may trigger cascading effects (Berdugo et al. 2020), such as: losses

All authors are members of the UNCCD Science-Policy Interface Committee and supporting scientists/consultants.

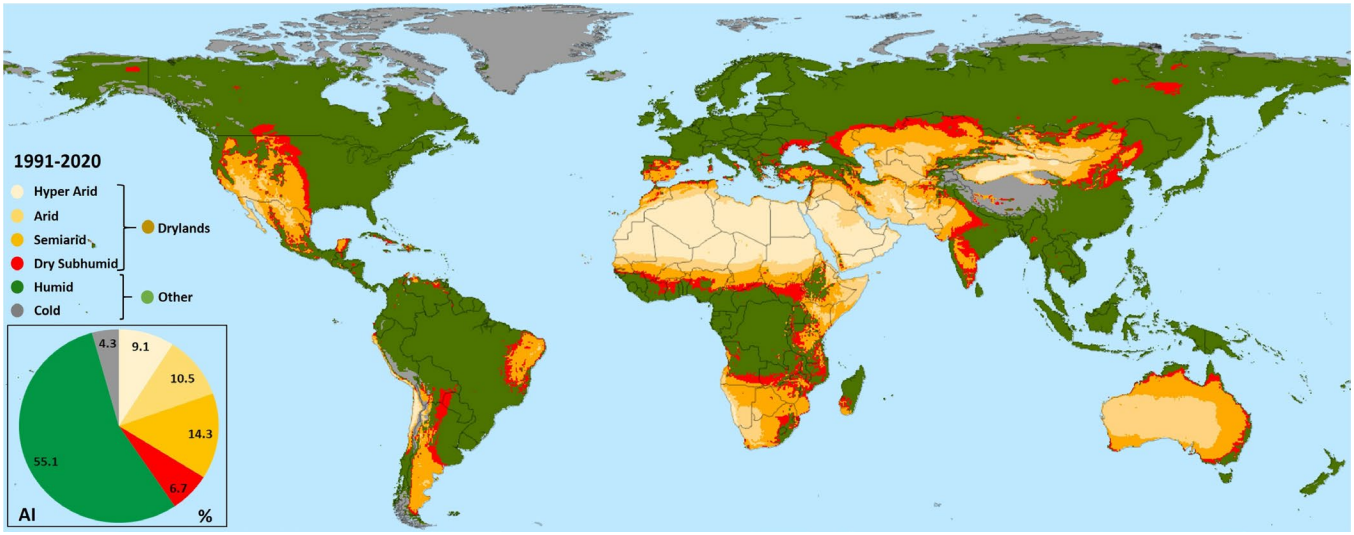

FIGURE 1 | Global map of the six aridity index (AI) classes for 1991–2020. The box shows the total percentage of Earth's lands within each AI class (Antarctica falls entirely in the cold class and is not included in this map nor in the global percentages). Map lines delineate study areas and do not necessarily depict accepted national boundaries.

in crop and plant productivity, biodiversity decline, ecosystem degradation, and increased wildfires. We show that more than a fifth of all land could experience abrupt ecosystem transformations in response to rising aridity by the end of the century.

The report identifies aridity as one of the most important causes of land degradation throughout multiple ecosystems worldwide (Prăvălie 2021). More 12.6% (5.43 million km^2) of drylands around the world have experienced land degradation caused by aridification (Burrell, Evans, and De Kauwe 2020), and 23% (31.1 million km^2)more global land is projected to be at "moderate" to "very high" risk of desertification in 2100 (Huang et al. 2020). A significant number of studies highlight the threat that increasing global aridity poses to terrestrial ecosystems, including risks from grasslands to tree species and overall plant productivity. In particular, forest ecosystems are especially sensitive to aridification. More trees are projected to die in response to greater water stress and reduced resistance to pests and pathogens, with forests expected to experience a progressive replacement by shrub species better adapted to drier conditions (McDowell and Allen 2015).

In drylands, aridity shows a strong negative correlation with species richness (García-Palacios et al. 2018) and the impacts of aridification on dryland biodiversity can dramatically affect both the structure and the fundamental processes of these ecosystems. A high percentage of all species among the world's mammals, reptiles, fish, amphibians and birds could lose their habitat due to unprecedented aridity if higher greenhouse gas emissions continue to spur climate warming throughout the century (Liu et al. 2023).

From an agricultural point of view, while droughts capture attention with their sudden and dramatic impacts on water availability, leading to immediate losses in agricultural production, the long-term effects of aridification on crop yields are more insidious and challenging to quantify, posing a largely silent but profound threat to global food security. Aridity projections point to future global losses of crop yields (Malpede and Percoco 2023), with particular implications for sub-Saharan Africa and Asia. Climate aridification is also likely to affect livestock production in the future by altering the quantity and quality of forage and available water, increasing heat stress and creating other local climate conditions to which a range of livestock species may not be adapted.

Wildfires and aridity are strongly interconnected. During the last decade, many severe and extreme wildfires have been documented, particularly in the semi-arid regions around the globe—and increased aridity is shown as the underlying common factor for larger and more severe wildfires (Brown et al. 2023). Increasing aridity is expected to play a key role in larger and more intense wildfires in the climate-altered future—not least due to its impacts on tree deaths in semi-arid forests and the consequent growing availability of dry biomass for burning (Goodwin et al. 2021).

Given the impact of aridity and aridification on global ecosystems and agri-food systems, addressing these challenges is a clear urgent priority in the face of current climate trends and future scenarios. The UNCCD report calls for immediate action to mitigate ecological and agricultural impacts and risks through integrated and sustainable adaptation strategies.

Adaptation measures to counteract increasing aridity encompass a diverse array of ecological and agricultural strategies. Incremental approaches, such as regreening degraded landscapes, sustainable land management, and farmer-managed natural regeneration, aim to enhance vegetation cover, reduce erosion, and improve soil fertility. Transformative measures, like the Great Green Wall initiative in the Sahel, though critiqued for potential biodiversity loss (Herrmann and Tappan 2013), have significantly increased vegetation cover and supported livelihoods. In agricultural adaptation, the development of drought-resistant crops and agroecological practices that promote crop diversification have proven effective in reducing vulnerability

while enhancing productivity (HLPE 2019). Integrating these sectoral strategies with policies supporting land degradation neutrality (Kust, Andreeva, and Cowie 2017), and sustainable ecosystem management offers a holistic framework for addressing aridity. As one of the most pressing drivers of land degradation and biodiversity loss globally, aridity necessitates coordinated international collaborations to address its multifaceted impacts. By presenting actionable recommendations and forward-looking insights, the UNCCD report serves as a crucial guide for policymakers, scientists, and stakeholders in confronting the global threat of drying lands.

Author Contributions

S.M. Vicente-Serrano: conceptualization, investigation, methodology, writing – original draft, writing – review and editing. **N.G. Pricope:** conceptualization, methodology, writing – original draft, writing – review and editing. **A. Toreti:** conceptualization, methodology, writing – original draft, writing – review and editing. **E. Morán-Tejeda:** conceptualization, methodology, writing – original draft, writing – review and editing. **J. Spinoni:** conceptualization, methodology, writing – original draft, writing – review and editing. **A. Ocampo-Melgar:** conceptualization, methodology, writing – original draft, writing – review and editing. **A. Diedhiou:** conceptualization, methodology, writing – original draft, writing – review and editing. **T. Mesbahzadeh:** conceptualization, methodology, writing – original draft, writing – review and editing. **Nijavalli H. Ravindranath:** conceptualization, methodology, writing – original draft, writing – review and editing. **R.S. Pulwarty:** conceptualization, methodology, writing – original draft, writing – review and editing. **S. Alibakhshi:** conceptualization, investigation, writing – original draft, writing – review and editing.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analysed for the current article.

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