EXPERT VOICES

Drylands under pressure: Science and solutions for global stability

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Drylands are the backbone of global agriculture, supporting 44% of the world's farming. Yet, they are under siege. Climate change, land degradation, and water scarcity are transforming these essential regions into barren landscapes, threatening the livelihoods of nearly three billion people. These lands, which already face some of the harshest conditions on Earth, are warming faster than other parts of the planet. Their decline imperils food security, biodiversity, and stability across vast swaths of the globe.

The crisis is accelerating. Water scarcity could displace 700 million people by 2030. Land degradation continues to erode agricultural productivity, while habitats vital to countless species disappear. This is not just an environmental issue—it is a humanitarian and economic one. Addressing desertification is no longer optional. It requires urgent, coordinated action grounded in science and innovation to restore degraded lands and build resilience.

Drylands are paradoxical landscapes—dynamic but fragile ecosystems facing persistent water scarcity, unpredictable rainfall, and vulnerability to land degradation—but still supporting millions of livelihoods. They sustain nearly half of global agriculture, yet they are among the most vulnerable of Earth's ecosystems. Every year, vast tracts of productive land are lost to land degradation. The cascading effects are far-reaching. Degraded soils lose their ability to store carbon, accelerating climate change. Essential ecosystem services such as water filtration and pollination collapse, further destabilizing these regions.

This degradation breeds conflict. Scarcity of land and water fuels competition, often erupting into violence and forcing migration. As desertification advances, communities are displaced, governance systems buckle, and tensions rise. The Sahel region of sub-Saharan Africa is a stark example. Several historical famines have been linked to prolonged droughts in the region. And climate change may further exacerbate risk, expanding drought-sensitive areas worldwide, turning once-stable ecosystems into high-risk zones. Without intervention, these pressures will only intensify, undermining global efforts for productivity, sustainability, peace, and security.

Reversing desertification and building resilience in drylands requires bold, science-driven solutions. Sustainable land management is at the heart of this effort. Conservation agriculture is one proven strategy. Minimal soil disturbance, crop rotation, and permanent soil cover help reduce erosion and restore soil health. In North Africa, CGIAR has helped farmers adopt these practices, boosting wheat yields while conserving water. Punjab, India, provides a compelling example, where the adoption of zero-tillage practices has increased soil organic carbon, improved water retention, and reduced emissions from residue burning. Over 3 years, zero-tillage adoption in the region grew by 18%, showcasing its potential to transform smallholder farming systems. Combining technical and social innovations enhances adoption of good practices, as reflected in participatory rangeland management in Kenya and Tanzania as well as payment for ecosystem services and carbon credits in countries including Zimbabwe and Colombia. Social innovations such as coidentification of issues, codevelopment of shared vision, and cocreation of solutions are instrumental to drive behavior and mindset changes.

Water scarcity is the defining challenge of drylands. Agriculture accounts for around 70% of freshwater use in these regions, leading to drastic groundwater depletion. Innovations such as rainwater harvesting, regeneration of groundwater, and environmental flows management are beginning to transform water management. The MENAdrought project ("MENA" meaning Middle East and North Africa) introduced advanced drought monitoring and governance systems in Morocco and Jordan. Improved governance in the region has been mainly informed by a shared understanding of the threat that water scarcity in the regions poses for livelihoods, well-being, and food security. This has resulted in the cocreation of the MENA Regional Innovation Hub to enhance water accessibility and governance. This partnership promotes and attracts investments in sustainable water management practices, essential for addressing the region's water scarcity issues. These tools ensure that limited water resources are used efficiently, even in the face of severe droughts.

Monocultures are a liability in drylands. They are highly vulnerable to climate shocks, pests, and diseases. As such, diversifying crops and cropping systems enhances resilience to climate change, reduces environmental impact, and supports biodiversity, which can sustain or even boost crop yields. Indeed, one-third of the world's soils have been degraded, contributing considerably to biodiversity loss—sometimes even to extinction. Diversifying farming systems—through mixed cropping, agroforestry, and integrated crop-livestock systems—builds resilience. In sub-Saharan Africa, projects such as Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) have demonstrated how these approaches stabilize yields, enhance biodiversity, and improve soil fertility, creating a safety net for farmers.

Additionally, soil, the foundation of agriculture, remains underexamined. It contains a vast network of microorganisms—billions of cells belonging to diverse taxa—of which we understand only a fraction. Greater investment in studying these organisms and their role in food production is vital. Regenerative practices demonstrate how working with nature can enhance soil health, boost productivity, and build resilience in drylands and elsewhere.

In December 2024, CGIAR unveiled its Global Strategy for Resilient Drylands at the 16th session of the Conference of the Parties (COP16) of the United Nations Convention to Combat Desertification (UNCCD) in Riyadh. This plan brings together the expertise of 15 research centers and partners to develop tailored solutions for dryland resilience. Built on decades of research, the strategy focuses on climate-smart innovations such as developing drought-resistant crops and climate-adaptive livestock systems and combining agriculture and solar energy production on the same land. It promotes ecosystem restoration by encouraging mixed cropping systems and integrating Indigenous knowledge to rebuild degraded landscapes. Crucially, it prioritizes inclusive governance, ensuring that women, youth, and marginalized communities are active participants in resource management and decision-making.

This integrated approach acknowledges the complexity of dryland challenges. It pairs technical and social innovations with systemic changes in how land, water, and livelihoods are managed.

Given the challenges, drylands have become a source of innovation. Across the globe, successful interventions are demonstrating how science-driven solutions can transform degraded landscapes into thriving ecosystems.

In Egypt, the Integrated Desert Farming Innovation Program has transformed 250,000 ha of desert into productive farmland. By combining solar-powered irrigation, climate-smart crops, and soil conservation techniques, the initiative has turned barren landscapes into hubs of economic activity.

In the Middle East and North Africa, the Enhancing Food Security in Arab Countries project, a 12-year initiative across 10 countries, has delivered transformative results for food security. Through innovative practices including conservation agriculture, advanced irrigation methods, and high-yield seed varieties, this project led to an increase in wheat productivity by an average of 29%, reaching up to 66% in some areas. Adoption rates for this array of practices were as high as 87%, directly benefiting more than two million people. This collaboration not only boosted productivity but also improved livelihoods and reduced import dependency, showcasing the power of regional partnerships in addressing global challenges. Morocco has set an ambitious goal to implement zero-till farming on one million hectares, emphasizing conservation agriculture to stabilize harvests, restore degraded soils, and enhance wheat yields through agronomic innovations, genetic gains, and productivity improvements.

Solar-powered irrigation systems that address the water-energy-food nexus are another bright spot. These systems reduce dependence on fossil fuels, making them a climate-friendly solution for water-scarce regions while boosting agricultural productivity. And business models tested in India helped farmers pump less water and then sell the surplus, creating important new revenue streams for their families. These models emphasize balancing economic benefits with protecting groundwater. In water-scarce regions, selling energy back to the grid curbs overpumping and encourages groundwater regeneration, while in water-abundant areas, surplus irrigation water can be shared responsibly through informal markets to support neighboring farmers without depleting resources.

The scale of desertification demands a global response. At UNCCD COP16, CGIAR called for stronger partnerships among governments, research institutions, and local communities. Collaboration is essential to scale innovations, mobilize funding, and ensure that solutions reach those who need them most. Capacity building is also critical. CGIAR emphasizes cocreating solutions with local communities to ensure that they are practical and culturally relevant. Gender-sensitive governance models, for example, empower women as key decision-makers in managing land and water resources.

And policy advocacy also plays a crucial role. By aligning with global frameworks such as the Rio Conventions (UNCCD, the Convention on Biological Diversity, and the United Nations Framework Convention on Climate Change) and the Sustainable Development Goals, we can shape policies that prioritize sustainable land management and climate adaptation. These frameworks provide a road map for advancing agroecology, forest and landscape restoration, and inclusive land-use planning—approaches that deliver critical benefits such as improved soil health, enhanced biodiversity, carbon sequestration, and strengthened food security.

Strengthening international collaboration on drought resilience and land degradation neutrality—restoring as much land as is degraded, keeping ecosystems stable—alongside mobilizing long-term investments and financial support, is essential to ensure that these solutions reach smallholder farmers and vulnerable communities. By embedding science-based advocacy into policy, we can drive the transformative change we need.

Desertification is one of the most urgent environmental crises of our time, but it is not insurmountable. Reclaiming degraded lands, optimizing resource use, and empowering local communities can lay the foundation for resilient food systems in drylands. Policy-makers, donors, and researchers must invest in innovations. Scaling effective interventions requires sustained funding and a commitment to advancing agricultural science. Community-led solutions are equally critical for long-term sustainability. Aligning conservation with food production ensures that drylands can support future generations.

Our drylands are at a tipping point. But with the right strategies, these landscapes can transition from crisis to opportunity. Science has shone a light on the path forward, demonstrating that resilience is possible when innovation meets action. By uniting behind this vision, we can ensure that drylands remain productive, vibrant ecosystems—not just for the billions who call them home but for the well-being of the entire planet.

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