

Plant diversity can help drylands resist grazing pressure¹



Source: ©Shutterstock/Mohammed Kamaludheen 2023.

Note: A shepherd tending a flock of sheep and goats, Saudi Arabia.

Drylands support livestock production but face overgrazing and land degradation

Drylands³ support about half of the world's livestock production and the livelihoods of nearly a billion people. Global increases in meat consumption are leading to increased livestock production, which in turn can threaten drylands with overgrazing and land degradation. Grazing effects, however, have been uneven. In some dryland areas, vegetation declines rapidly as grazing intensifies, while in others, the ecosystems remain surprisingly resilient. Understanding the reasons for this variation can point to strategies for managing drylands sustainably, including those in Saudi Arabia, where grazing dominates land use.⁴

Most previous research on this topic has had a local or regional focus, leading to ecosystem-specific conclusions. A KAUST-led global study looked at multiple variables, including differences in precipitation, temperature, soils, plant composition, and herbivores, to identify underlying mechanisms of grazing pressures and land degradation, as well as strategies to address them. The researchers found that plant species diversity, including the total number of plant species at a dryland grazing site, consistently helped drylands resist grazing pressure.

The bottom line

- This KAUST-led² global study suggests plant diversity can help reduce grazing pressures on drylands such as those in Saudi Arabia.
- Grazing practices that allow plant species recovery, maintain plant variety, and support mixed livestock can also mitigate grazing pressures and prevent land degradation.
- The researchers' uniquely global approach, which compared conditions at 73 sites on six continents, allowed the team to identify underlying mechanisms of grazing pressures and land degradation.
- The research suggests more broadly that biodiversity is not just a conservation goal but is needed for sustainable livestock production.
- Ongoing work includes a survey of major ecosystems in Saudi Arabia, where grazing dominates land use.



Grazing practices can mitigate grazing pressure and prevent land degradation

The KAUST-led study suggests adopting land management strategies that conserve plant richness and minimize vegetation loss to prevent degradation at dryland grazing sites. More specifically, the research points to

- **Promoting grazing systems that allow plant species recovery.** Targeted or rotational grazing systems that include rest periods can prevent continuous pressure on palatable plants.
- **Avoiding practices that reduce the variety of plants or promote excessive shrub dominance.** High shrub dominance can reduce forage quantity and plant species richness, placing greater pressure on remaining palatable plants. However, shrubs also provide important ecosystem functions, so management should address excessive dominance rather than shrub presence itself.
- **Supporting mixed livestock systems.** Mixed-species grazing, under equivalent grazing pressure, often has less negative impact on plant diversity and cover than single-species grazing, such as that by sheep or other livestock alone.

Maintaining plant diversity is not about introducing new plant species but about conserving the species already present in these ecosystems, including plants that are adapted to local conditions.⁵ While the number of animals on a dryland grazing site also matters, sustainable grazing cannot rely only on reducing such numbers without also promoting and protecting plant diversity.

Effects of plant diversity are evident in drylands worldwide

The effects of plant diversity are evident even after accounting for differences in climate, soils, and grazing management. More diverse plant communities lose less vegetation under grazing pressure.

Plant functional diversity, a measure of the variety of characteristics that influence how plant species function and the range of ecological strategies they represent, explains much of this pattern. Different plant species use resources in complementary ways and have different means of coping with grazing. Some evade grazing, while others tolerate it and recover quickly. Functional diversity helps distribute grazing pressure across plant species and helps ecosystems better maintain their structure.

Plant species may also differ in how they grow, their palatability to grazing animals, the depth of their roots, and their chemical defenses. Together, such differences can help

drylands resist the effects of grazing pressure. Drylands with less diverse plants may be more vulnerable to degradation and overgrazing.

Overall, the researchers found that grazing pressure was reducing vegetation cover in 80% of the drylands studied, with an average decline of about 35%. The researchers assessed the effects of grazing by comparing areas at different distances from watering points. Grazing pressure typically declines with distance.



Source: Courtney Currier 2017, used with permission.

Note: Taken in the Jornada Basin, southern New Mexico, U.S. Appropriate rest periods can allow vegetation to recover, helping maintain plant diversity and ecosystem resistance to grazing pressure.

New research underway in Saudi Arabia will complement a uniquely global perspective

Representing a substantial departure from past studies, the research team evaluated 146 plots in 73 experimental sites across 25 countries on six continents (Figure 1). The sites were all rangelands, that is, areas with vegetation grazed by wild or domestic hoofed animals (e.g., cattle, goats, horses, and sheep). The sites varied by vegetation type (e.g., grasslands, steppes, shrublands, and savannas), climatic conditions, soil types, and grazing characteristics. The global perspective of the KAUST-led study allowed the researchers to identify general patterns and underlying mechanisms that are more difficult to identify in local or regional studies because of their context dependence.

The results are particularly relevant for Saudi Arabia, an exceptionally dry country where grazing dominates land use.^{4,6} KAUST researchers are now extending this research by surveying major ecosystems in Saudi Arabia (Figure 1). This work will contribute to a better overall understanding of the response of drylands to grazing pressure and can inform the development of evidence-based land management strategies that will meet the needs of the Kingdom.



Summing up

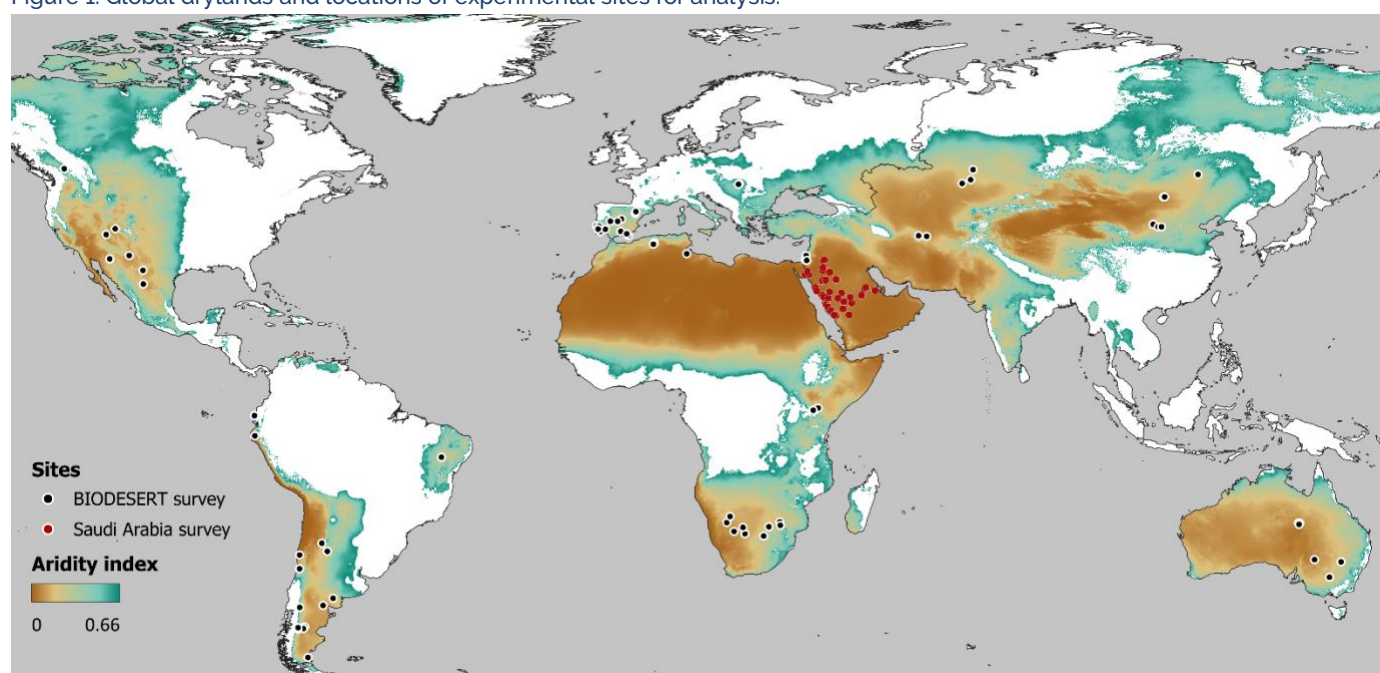
Increasing demand for meat may increase grazing pressure on drylands where water is scarce but where about half of the world's livestock is raised. Such lands, which are widespread in Saudi Arabia, support the livelihoods of nearly a billion people worldwide, underscoring the importance of good management for them.

The KAUST-led research team evaluated drylands globally, enabling it to draw lessons about grazing pressures and land degradation that previous research on local and regional drylands could not. The team suggests adopting land

management strategies that can help maintain plant diversity to reduce grazing pressures and prevent land degradation. The research points more specifically to promoting grazing systems that allow plant species recovery, avoiding practices that reduce the variety of plants or lead to shrub dominance, and supporting mixed livestock systems.

Finally, the research suggests more broadly that biodiversity is not just a conservation goal but is needed for sustainable livestock production.⁵ Conserving plant diversity can help reduce the risk of land degradation, even under increasing grazing pressure.

Figure 1. Global drylands and locations of experimental sites for analysis.



Source: Lucio Biancari 2026, created for this Policy Brief.

Note: The aridity index indicates the proportion of annual precipitation relative to the amount of water that could potentially evaporate into the atmosphere; lower values indicate drier conditions.



جامعة الملك عبد الله
للعلوم والتقنية
King Abdullah University of
Science and Technology

About the KAUST Researchers



Lucio Biancari

Postdoctoral Researcher
King Abdullah University of Science and Technology



Fernando Maestre

Professor and Chair, Environmental Science and Engineering
[View full profile on kaust.edu.sa](https://www.kaust.edu.sa)

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King Abdullah University of Science and Technology
Building 16 Level 3, Room 3612
Thuwal 23955-6900, Saudi Arabia

1. This Policy Brief summarizes findings from Biancari, Lucio, Gastón R. Oñatibia, Yoann Le Bagousse-Pinguet, Nicolas Gross, Laura Yahdjian, Martín R. Aguiar, Hugo Saiz, David J. Eldridge, Enrique Valencia, Xoaquín Moreira, Victoria Ochoa, Beatriz Gozalo, Sergio Asensio, César Plaza, Emilio Guirado, Miguel García-Gómez, Juan J. Gaitán, Jaime Martínez-Valderrama, Betty J. Mendoza, and Fernando T. Maestre. 2026. "Plant Diversity Enhances Ecosystem Resistance to Increasing Grazing Pressure in Global Drylands." *Nature Ecology & Evolution* 10: 258-266. <https://doi.org/10.1038/s41559-025-02952-9>. All rights and any third-party permissions remain with the respective rightsholders. It also includes additional insights provided by Dr. Biancari in a separate communication and comments from Professor Maestre presented in KAUST Discovery, 2026. "Plant Diversity Reduces the Impacts of Grazing Pressure in Drylands."
2. King Abdullah University of Science and Technology (KAUST).
3. Drylands are ecosystems where vegetation growth and productivity are limited by water availability.
4. For further information on land use in Saudi Arabia, see Food and Agriculture Organization of the United Nations, Arab Forum for Rural Advisory Services (AFRAS). "Country Brief – Saudi Arabia." 2025. <https://openknowledge.fao.org/server/api/core/bitstreams/f697c249-5e50-4636-8531-8bb046b1776a/content>.
5. Dr. Biancari drew these conclusions from the findings of the study.
6. See Professor Maestre's comments on conditions in Saudi Arabia and the survey in KAUST Discovery 2026.