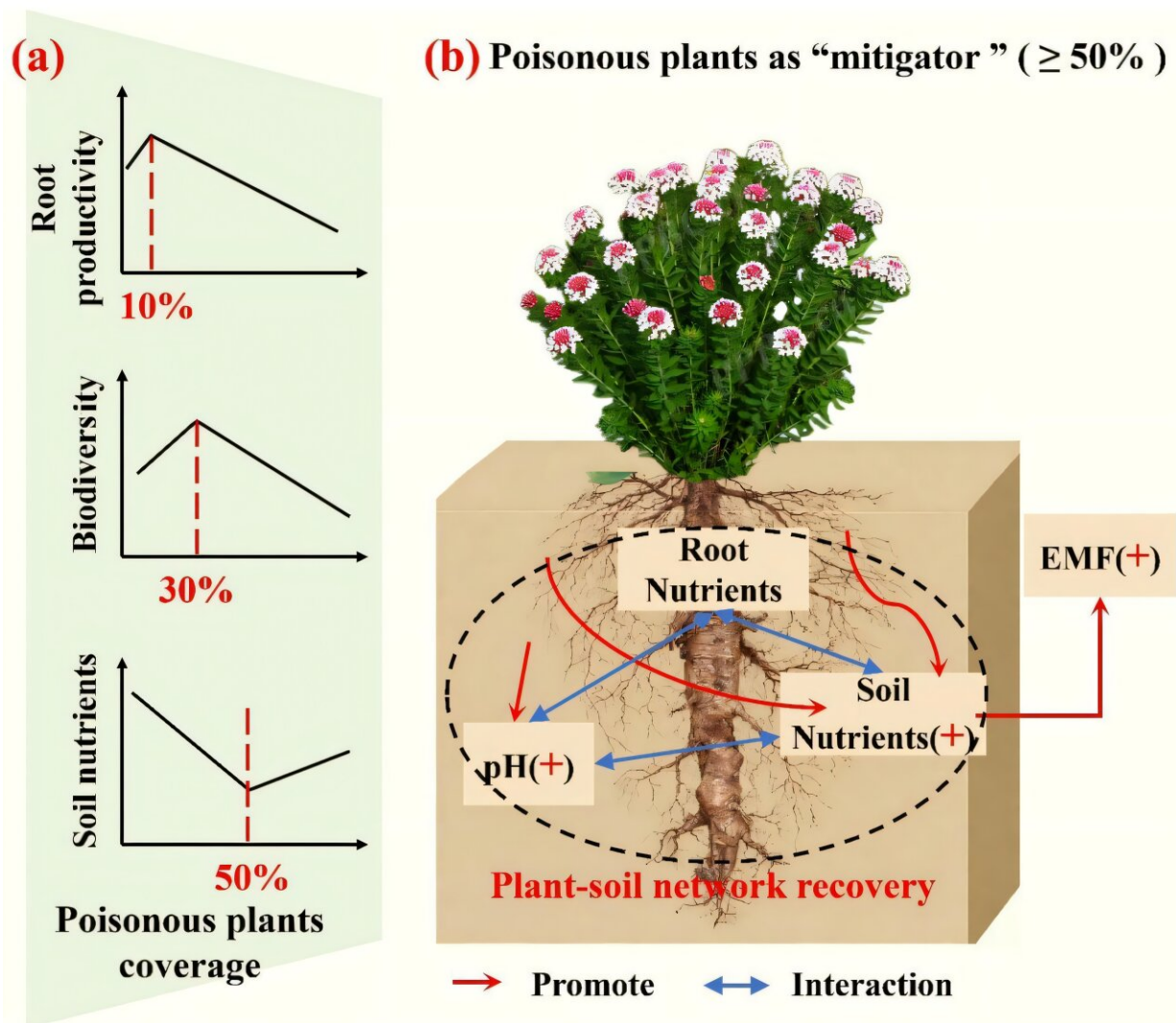


Grasslands are facing a threat of poisonous plant takeover—but there's a surprising upside

May 14 2026, by Krystal Kasal



Sequence of abrupt response shifts in grassland as poisonous plants coverage

increases (a) and ecological role of poisonous plants as mitigator (b). Credit: *Communications Earth & Environment* (2026). DOI: 10.1038/s43247-026-03581-1

Grasslands provide food for millions of grazing animals across the world, but overgrazing along with climate change make these valuable ecosystems vulnerable to invaders. In particular, certain species of poisonous plants have been taking over grasslands, reducing the availability of food for grazing animals and causing changes in local ecosystems.

A new study, [published](#) in *Communications Earth & Environment*, aimed to determine the thresholds associated with poisonous plant encroachment, but the researchers also found that the takeover of grasslands by poisonous plants offered a surprising benefit after a certain tipping point.

The spread of poisonous plants across grasslands

Some poisonous plants have specialized methods for spreading across their chosen environments, such as the release of phytotoxins, rapid reproduction, and particularly efficient dispersal mechanisms. And as livestock continuously feed on other available plants, the poisonous plants that they avoid have more space to spread.

Past studies have shown mixed effects from the spread of poisonous plants in grasslands. Some have indicated that poisonous plants reduce biodiversity and soil quality, but others have seen improvements in soil nutrients and microbial diversity. The authors of the new study wanted to better understand the relationships between the stage of poisonous plant takeover and the effects that they have on the environment, and they say

the key is to determine the ecological thresholds that often serve as early warnings for ecosystem degradation risks.

Are poisonous plants harmful or helpful?

The research team surveyed 465 grassland field plots across the Qinghai-Tibetan Plateau in China, which are used for grazing. They measured 20 ecosystem variables, spanning different levels of poisonous plant encroachment. Variables included things like root growth, plant diversity and the amount of carbon or nitrogen in the soil. The team then used statistical models to identify thresholds where ecosystem properties changed abruptly.

What they found was a complicated system, in which there is not a simple answer to whether poisonous plants were harming or helping the ecosystem. In some ways, they caused harm, but only up to a certain threshold. And in other ways, they helped after a certain threshold was reached.

They found that root productivity, for example, drops sharply when poisonous plants cover more than 10% of an area, and that biodiversity declines significantly at 30% poisonous plant coverage. However, they found that ecosystem multifunctionality and plant–soil network complexity partially recover after 50% coverage, suggesting poisonous plants shift from being harmful to somewhat mitigating further degradation of the grassland. Furthermore, they found that nutrients in the soil increased abruptly when coverage exceeds 50%.

"Importantly, the interaction between root and soil variables recovered, a key indicator of ecosystem restoration. Roots promote nutrient cycling and regeneration by releasing exudates, regulating microbial communities, and increasing organic matter input, which, in turn, enhances root growth and nutrient uptake, thereby forming a positive

feedback mechanism. Such a bidirectional interaction not only contributes to improved [soil fertility](#) and ecosystem productivity, but also enhances community stability under grazing pressure or climatic stress," the study authors explain.

The researchers note, though, that recovery does not necessarily mean that ecosystem structures or functions return fully to their pre-encroachment states, but that a certain degree of rebound occurs in ecosystem multifunctionality and plant–soil network complexity when poisonous plant coverage exceeds 50%. Also, grasslands with this much poisonous plant coverage aren't very useful for grazing land, even when soil health and ecosystem multifunctionality improve.

Thresholds and stage-specific management

Because the study only took place in the Qinghai-Tibetan Plateau, the findings may not apply to all types of grasslands. The researchers encourage future studies to explore microbial and functional processes in other grassland types. However, these results are still useful for adaptive management strategies for grassland restoration. The clear thresholds provided by the study can help land managers when to act to reduce irreversible damage to grazing land.

The study authors write, "We suggest that the dual ecological role of poisonous plants should be viewed dialectically, depending on their coverage. At low poisonous plant coverage, management should aim to maintain their coverage below 30% to preserve the biodiversity–ecosystem multifunctionality relationship. Once poisonous plant coverage exceeds 50%, it drives the shift in grassland community type from a sedge-grasses community to a forb community, potentially making natural restoration more difficult."

More information: Lingyan Qi et al, Ecological thresholds of

poisonous plants encroachment in grassland ecosystems of the Qinghai-Tibetan Plateau, *Communications Earth & Environment* (2026). DOI: [10.1038/s43247-026-03581-1](https://doi.org/10.1038/s43247-026-03581-1)

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