FOOD FORWARD NDCs

Implementing improved management practices in grasslands

Overview

Grasslands can be defined as landscapes with vegetation dominated by grasses, with little or no tree cover. Savannahs are a grassland ecosystem. Grasslands cover about **40 percent of the global land surface**. They play a crucial role in removing carbon dioxide (CO_2) from the atmosphere, as they store about **34 percent of global terrestrial carbon, 90 percent of which accumulates in grassland soils.** However, if degraded or converted to other land uses, grasslands may become a net source of CO_2 emissions. Currently, grasslands are undergoing land-use conversion and severe degradation (**about 50% of global grassland area has been degraded**), which reduces their capacity to provide climate, ecosystems, and social benefits.

Managed grasslands are used worldwide to support livestock production by mowing or grazing. Around **69 percent of the world's agricultural area** is made up of grasslands. Managed grasslands systems emit methane (CH_4) from grazing livestock and nitrous oxide (N_2O) from soils and animal manure. Poor management of grasslands for agriculture can degrade these ecosystems.

Despite their importance and climate mitigation potential, grassland ecosystems are often marginalized in national climate policies and strategies.

Concrete measures to implement

Protecting grasslands and savannahs and the ecosystem services they provide requires conscious management and a mixture of protected areas, sustainable management, and focused restoration.

- Assess drivers of loss and degradation of natural grassland and savannah and assess the impact of climate change on natural and semi-natural grasslands.
- **Avoid conversion of grasslands** into cropland or other land uses. Grassland soils store a large amount of organic carbon that, if exposed to the atmosphere (e.g., through tillage), is mostly released to the atmosphere in form of CO_2 emissions. Avoiding conversion of grasslands into croplands is therefore the foremost strategy to avoid CO_2 emissions from these lands.
- Transition from '**grassland degradation**' to '**grassland restoration**.' Degraded grasslands are usually characterized by reduced vegetation, declines in soil organic matter, soil erosion, decreased productivity, and/or loss of biodiversity. Restorative interventions include activities that aim to recover native grass cover through revegetation, natural regeneration, and assisted natural regeneration. These interventions aim to enhance grasslands as land carbon sinks and restore the wider ecosystem functions.
- **Improve animal grazing**. Over-grazing (e.g., too many grazing animals per hectare, or continuous-grazing management) is a major driver of grassland degradation, which reduces productivity and increases GHG emissions. Improved grazing strategies are context dependent, but optimizing grazing intensity (e.g., rotational grazing) has been shown to be to effective, especially in Latin America, Africa, and Asia. **Rotational grazing**, as opposed to continuous grazing, allows the vegetation to recover between grazing events. Optimal use of grasslands for animals can be achieved by varying the species, number, or distribution of animals on the land.
- **Improve fire regimes**. Proactive fire management can increase carbon sequestration and reduce GHG emissions. This can be achieved by prescribing burning or mechanical vegetation thinning to reduce biomass-fuel loads and thus the risk of uncontrolled wildfires. However, fire management practices for climate mitigation are context-specific and can entail trade-offs (e.g., on biodiversity), and their effectiveness is still under scrutiny by the scientific community.

Enabling governance measures

- Adopt a more cohesive national policy framework and a robust ecosystem classification system to successfully conserve and restore grasslands. A cohesive framework would consider grasslands' carbon sequestration potential, emissions arising from their conversion, and roles for biodiversity protection before targeting grasslands as sites for afforestation.
- Recognise and respect the role of traditional governance structures and practices by Indigenous Peoples and local communities for managing grasslands in ways that build resilience to extreme events.
- Recognise and enable pastoral mobility as a strategy for climate change adaptation and sustainable land management by Indigenous people, local communities, farmers, and herders.
- Implement capacity building support for Indigenous people, local communities, farmers, and herders to adopt sustainable livestock grazing and management practices. Invest in decent employment and livelihood opportunities, especially for women and youth – for instance, through investment in entrepreneurship, enterprise, smallholders and family operations – to ensure the existence of inclusive, equitable, and decent opportunities to generate income, including outside of livestock grazing.
- Assess the economic value and benefits of ecosystem services delivered through a shift to more sustainable grazing practices, such soil carbon storage, climate change adaptation potential, and diversity of pollinator communities increasing crop productivity.
- Promote payment for ecosystem services through public-private partnerships.
- Implement agricultural subsidies that support and incentivise less intensive, sustainable agricultural practices, recognising the rights of Indigenous people and local communities and collaborating with these groups in inclusive ways.
- Promote product certification and labelling schemes for nature-positive agricultural management practices.

Tools and MRV systems to monitor progress

Calculators and Trackers

GrassSignal

GrassSignal, is a decision support tool for sustainable grassland monitoring.

Link: https://business.esa.int/projects/grasssignal

Data resources

Livestock MRV in Ethiopia and Kenya

Livestock MRV in Ethiopia and Kenya, is an inventory of GHG from livestock based on IPCC Tier 2 methodology.

Link: https://cgspace.cgiar.org/items/3f9d7933-ef5e-45b3-9fab-2fd5884a2f2f

---

Data to estimate grasslands livestock carrying capacity

Data to estimate grasslands livestock carrying capacity, from Piipponen et al. (2022)

Link: https://zenodo.org/records/6366896

Pastoralism and Resilience of Food Production in the Face of Climate Change

Link: https://www.giz.de/de/downloads/giz2022-en-technical-background-paper-climate-resilience-and-pastoralism.pdf

---

Mitigation benefits

- According to FAO (2023), improving management practices on grasslands via incorporation of organic manures, agroforestry practices, and rotational grazing could sequester 2 $GtCO_2$ per year in top soils.
- Roe et al. (2021) estimated that enhancing soil carbon sequestration in grazing lands could sequester 0.13-2.56 $GtCO_2$ per year; reducing conversion of savannas and natural grasslands could avoid 0.03-0.12

$GtCO_2$ per year; and reduced N_2O emissions from manures on pastures could avoid an additional 0.01 $GtCO_2$ per year.

Other environmental benefits

- Grasslands play an important role in cooling the ground through the process of transpiration. This helps to combat overheating in grass-fed cattle and overall protects biodiversity.

Adaptation benefits

- Soil erosion control: degraded grasslands are typically characterized by sparse vegetation cover and compacted soils, which make them prone to soil erosion by water and wind, and thus further degradation. Reducing soil erosion is essential to ensure long-term productivity and functionality of grasslands and reduces vulnerability of local production systems to climate change.
- Water supply and flow regulation: the permanent vegetation cover on grasslands can enable more water infiltration in the soil, enhance water

retention in the soil profile, and reduce run-off, thereby regulating the water flow downstream (e.g., less intense floods, and longer provision of water throughout the season).

- Pollination: grasslands not only sustain livestock but also other economic activities in the surrounding areas. Particularly, they are an important habitat for pollinator species that are of crucial importance for the productivity of many agricultural crops (e.g., fruit trees).

Other sustainable development benefits

- Food security and sustainable livelihoods: restoring and improving grassland management increases their forage productivity, which is key for sustaining livestock and local population. The benefit resulting from increase water supply and pollination will sustain local agriculture and general food security.
- Biodiversity: conversion of grasslands to croplands or other land uses is a major driver of biodiversity loss. Therefore, conservation of semi-natural grasslands and their sustainable management is strategic for biodiversity conservation and its multiple benefits (e.g., pollination, pest control, tourism).
- Culture: in many regions, grasslands are an important element of the landscape, intertwined with local cultures, attractive for recreational purposes due to their high aesthetic value, and of interest for educational and research purposes.

Implementation challenges and potential externalities and trade-offs

- Grassland conservation and restoration might lead to conflicts with other land uses, such as agriculture or infrastructure expansion. This might be reflected in the different perceived values of grasslands by different stakeholder groups (e.g., pastoralism, foresters, local population, decision makers).
- Avoiding grassland conversion could be tackled by intensifying productivity on current croplands. However, agricultural intensification might lead to increasing emissions from, for example, higher fertilization rates.

Measures to address challenges and potential externalities and trade-offs

- Conservation and restoration initiatives that might generate trade-offs need to first build a common understanding of the value of grasslands among stakeholders, ensuring inclusive and participatory approaches with local and Indigenous groups.
- Conservation and restoration efforts need to be designed as part of comprehensive sustainable development plans that also consider the effects on other land uses and possible trade-offs. For example, to ensure the long-term sustainability of interventions such as increasing cropland productivity to prevent the conversion of grasslands, it is important to adopt sustainable intensification strategies such as regenerative or climate-smart agriculture practices.

Implementation costs

- Restoration costs of grasslands in 200 European projects (including different restoration techniques) were estimated to be on average EUR 1,227 per hectare.
- Calculations of the economic viability of interventions should also consider the massive costs that grassland degradation has on livestock production, which over the period of 2001-11, was estimated at around at $6.8 billion globally. The impacts of grassland degradation on livestock is particularly severe in regions where most the population is below the poverty line.

Interventions in practice

In the Inner Mongolia Autonomous Region (China), an increasing rural population and number of domestic livestock was putting the land under intense pressure, with increasing degradation and desertification of grasslands. Restoration efforts focused on planting trees had proven mostly unsuccessful. A pilot study tested the potential for natural revegetation by protecting the land from grazing, while planting forage crops on smaller plots to sustain local livestock. After only a few years after the project start, the grassland restoration has proven so successful that the Chinese government has revised its policies

in favour of grasslands protection. More information and projects can be retrieved from the **Society for Ecological Restoration's project database**.

References

1. Bai, Y., & Cotrufo, M. F. (2022). Grassland soil carbon sequestration: Current understanding, challenges, and solutions. *Science*, *377*(6606), 603–608.
2. Bardgett, R. D., Bullock, J. M., Lavorel, S., Manning, P., Schaffner, U., Ostle, N., et al. (2021). Combatting global grassland degradation. *Nature Reviews Earth & Environment*, *2*(10), 720–735.
3. Bengtsson, J., Bullock, J. M., Egoh, B., Everson, C., Everson, T., O'Connor, T., et al. (2019). Grasslands—more important for ecosystem services than you might think. *Ecosphere*, *10*(2), e02582.
4. Chang, J., Ciais, P., Gasser, T., Smith, P., Herrero, M., Havlík, P., et al. (2021). Climate warming from managed grasslands cancels the cooling effect of carbon sinks in sparsely grazed and natural grasslands. *Nature Communications*, *12*(1), 118.
5. Da Veiga, R. M., & Nikolakis, W. (2022). Fire Management and Carbon Programs: A Systematic Literature Review and Case Study Analysis. *Society & Natural Resources*, *35*(8), 896–913.
6. Eshete, S., Tadesse, M., Baker, D., Wilkes, A., & Solomon, D. (2021). Piloting innovations for improved data collection and management to support livestock monitoring, reporting, and verification (MRV) of greenhouse gas emissions in Ethiopia. Retrieved February 6, 2024, from https://hdl.handle.net/10568/116277.
7. FAO. (2023). *Global assessment of soil carbon in grasslands: From current stock estimates to sequestration potential*. Retrieved from https://www.fao.org/documents/card/en/c/cc3981en.
8. GIZ (2022). Pastoralism and resilience of food production in the face of climate change. Retrieved from https://www.giz.de/de/downloads/giz2022-en-technical-background-paper-climate-resilience-and-pastoralism.pdf
9. *Grassland of the world*. (2005). Retrieved from https://www.fao.org/documents/card/en?details=71c9e309-7d69-57c1-8915-f159643349ee/
10. GrassSignal – ESA Space Solutions. (n.d.). Retrieved February 6, 2024, from https://business.esa.int/projects/grasssignal.
11. Griscom, B. W., Adams, J., Ellis, P. W., Houghton, R. A., Lomax, G., Miteva, D. A., et al. (2017). Natural climate solutions. *Proceedings of the National Academy of Sciences*, *114*(44), 11645–11650.

12. HLPE (2023). *Reducing inequalities for food security and nutrition*. Rome, CFS HLPE-FSN. Available from https://www.fao.org/cfs/cfs-hlpe/insights/news-insights/news-detail/reducing-inequalities-for-food-security-and-nutrition/en.
13. Lahiri, S., Roy, A., & Fleischman, F. (2023). Grassland conservation and restoration in India: a governance crisis. *Restoration Ecology*, *31*(4), e13858.
14. Liu, L., Sayer, E. J., Deng, M., Li, P., Liu, W., Wang, X., et al. (2023). The grassland carbon cycle: Mechanisms, responses to global changes, and potential contribution to carbon neutrality. *Fundamental Research*, *3*(2), 209–218.
15. Meli, P., Schweizer, D., Winowiecki, L. A., Chomba, S., Aynekulu, E., & Guariguata, M. R. (2023). Mapping the information landscape of the United Nations Decade on Ecosystem Restoration Strategy. *Restoration Ecology*, *31*(1), e13810.
16. Piipponen, J., Jalava, M., Leeuw, J. de, Rizayeva, A., Godde, C., Cramer, G., et al. (2022). Global trends in grassland carrying capacity and relative stocking density of livestock. *Global Change Biology*, *28*(12), 3902–3919.
17. Restoration Resource Center Project Database. (n.d.). Retrieved February 6, 2024, from https://ser-rrc.org/project-database/.
18. Roe, S., Streck, C., Beach, R., Busch, J., Chapman, M., Daioglou, V., et al. (2021). Land-based measures to mitigate climate change: Potential and feasibility by country. *Global Change Biology*, *27*(23), 6025–6058.
19. Seddon, N., Sengupta, S., García-Espinosa, M., Hauler, I., Herr, D., & Raza Rizvi, A. (2019). *Nature-based Solutions in Nationally Determined Contributions: Synthesis and recommendations for enhancing climate ambition and action by 2020*. Retrieved from https://portals.iucn.org/library/sites/library/files/documents/2019-030-En.pdf
20. Sustainable Rice Platform. (n.d.). Retrieved February 6, 2024, from https://sustainablerice.org/.