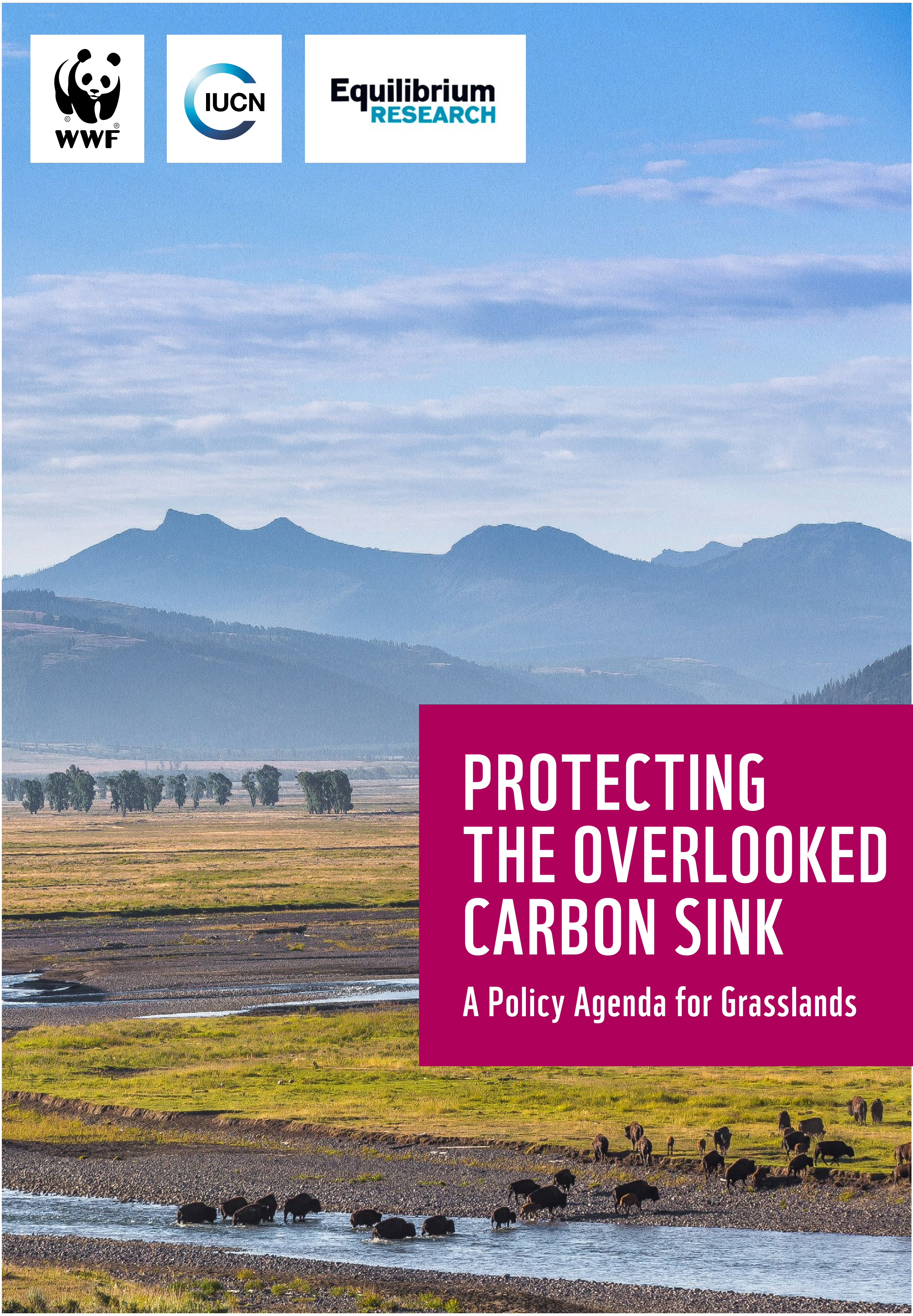

PROTECTING THE OVERLOOKED CARBON SINK

A Policy Agenda for Grasslands

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CONTENTS

KEY MESSAGES

Grasslands hold globally significant carbon sinks, mainly as soil organic carbon. While they store less carbon per hectare than forests, in fire-prone areas they may be a more reliable option.

These carbon sinks need active management, including optimising grazing intensity, choice of livestock, use of set asides, encouraging native species and controlling invasive species.

Grasslands contribute many ecosystem services that help climate adaptation, including water and food security, soil stabilisation and control of desertification.

However, **many grassland carbon sinks are threatened by conversion to other land uses**, including afforestation of natural grassland.

Conservation of natural grasslands and restoration of degraded grasslands would have multiple benefits for climate stabilisation, biodiversity conservation and other ecosystem services.

KEY GRASSLAND-CARBON POLICIES

UNFCCC signatories can help by promoting **key grassland-carbon policies:**

01 Recognise grasslands as important and stable carbon sinks and include them in Nationally Determined Contributions (NDCs).

02 Integrate grasslands across the Rio conventions (UNFCCC, UNCCD and the CBD), the UN Sustainable Development Goals and the UN Decade on Ecosystem Restoration supporting protection, sustainable management and restoration.

03 Remove perverse incentives for crop production or afforestation under climate mitigation.

04 Support smallholder, pastoralist and transhumant communities, their culture and production systems, as key to ensuring sustainable and climate-friendly grassland management.

05 Safeguard against weakening systems that maintain grasslands and prevent woody encroachment such as traditional burning practices or native wildlife and ecosystem engineers.

1. INTRODUCTION

GRASSLANDS ARE MAJOR CARBON SINKS

Up to **90%** of grassland carbon is stored below ground in roots and as soil organic carbon (SOC)

Well managed and conserved grasslands play key but often unrecognised roles in countering climate change. Benefits come through the provision of ecosystem services to help us adapt to a changing climate and–our main focus here–because they store and sequester huge reserves of carbon.

The size of global grasslands* makes them a major global store,[1] containing 25-35% of terrestrial carbon,[2, 3, 4] and playing a key role in mitigating climate change.[5] In Tanzania for instance, although miombo savannahs only store 10-20% of the carbon per area stored in closed forest, the huge area of miombo makes it a more important carbon sink overall.[6] Up to 90% of grassland carbon is stored below ground in roots and as soil organic carbon (SOC).[7, 8, 9, 10] Grassland plant diversity seems to be positively correlated with SOC, particularly in warm and arid climates and because it increases microbial activity.[11, 12, 13, 14] Natural grasslands therefore sequester and store more carbon than modern agricultural landscapes planted with a single species of grass.[15] Carbon storage is influenced by herbivores and predators, which help maintain a healthy ecosystem.[16, 17, 18] Protection of SOC is most effective when combined with conservation,[19, 20] by protecting ancient grassland, restoring degraded grassland and appropriate reseeding. [21, 22]

*Here we use "grassland" as a shorthand for grassland, savannah and many rangelands; any area on which the vegetation comprises predominantly indigenous unsown grasses, grass-like plants, forbs or shrubs.

2. ANALYSIS

GRASSLAND CARBON SINKS ARE STILL POORLY UNDERSTOOD AND OFTEN UNDER THREAT

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Many governments remain uncertain about the extent and importance of grassland carbon sinks. Accurate statistics are hampered by disagreements about where grasslands merge into forests and wetlands[23] by variations in sequestration and storage between grassland ecosystems[24, 25, 26] and by inaccuracy in use of satellite data to estimate grassland SOC.[27] Local carbon mapping can help to overcome incomplete global statistics.[28] Importantly, grassland can be a more reliable carbon sink than forests in high fire risk areas,[29, 30] because cooler grass fires do not release much SOC,[31, 32] or destroy soil microorganisms,[33] while hotter, intense forest fires can lead to greater emissions overall.

2.1 Grassland carbon sinks need active management policies

However, almost everywhere grasslands are at risk, undergoing a higher rate of conversion,[34, 35, 36] fragmentation[37, 38] and degradation[39, 40, 41] than any other biome. Further pressures come from pollution,[42, 43, 44, 45] and from invasive species, including exotic species.[46, 47, 48] Poorly planned forest conservation efforts have at times caused leakage of agricultural expansion towards grasslands and savannahs.[49]

Remaining grasslands and savannahs need to be managed in ways that maximise their SOC and other climate benefits.[50] Both overgrazing[51] and under-grazing[52] can be damaging, so in managed rangelands optimising grazing intensity is important. Carbon management may mean adapting livestock management according to conditions.[53] Choice of livestock is significant; different species and even different breeds of livestock have different grazing patterns which can affect the health of grasslands; in general if livestock are present they should be closest to the natural herbivores that have evolved in the ecosystem.[54, 55, 56] Grazing by livestock is not suitable in all grassland ecosystems.[57, 58] Alternatively, farming or managed offtake of wild herbivores may be a more sustainable option. Countries like Namibia have a growing legal native herbivore market and wild meat is seen as an adaptation strategy to climate change.[59] Changing from continuous to rotational grazing has been reported as increasing SOC significantly,[60] as has a switch from high to moderate grazing.[61, 62]

Temporary grazing exclusion[63, 64] can have positive impacts on SOC,[65] biodiversity and other ecosystem services[66] and should be factored into many livestock systems. Finally control of pollution, particularly fertilizers

Global grasslands contain
25 –35%
of terrestrial carbon

and various pesticides and herbicides, and control of invasive species, are all critical factors in increasing the role of grasslands in carbon mitigation.

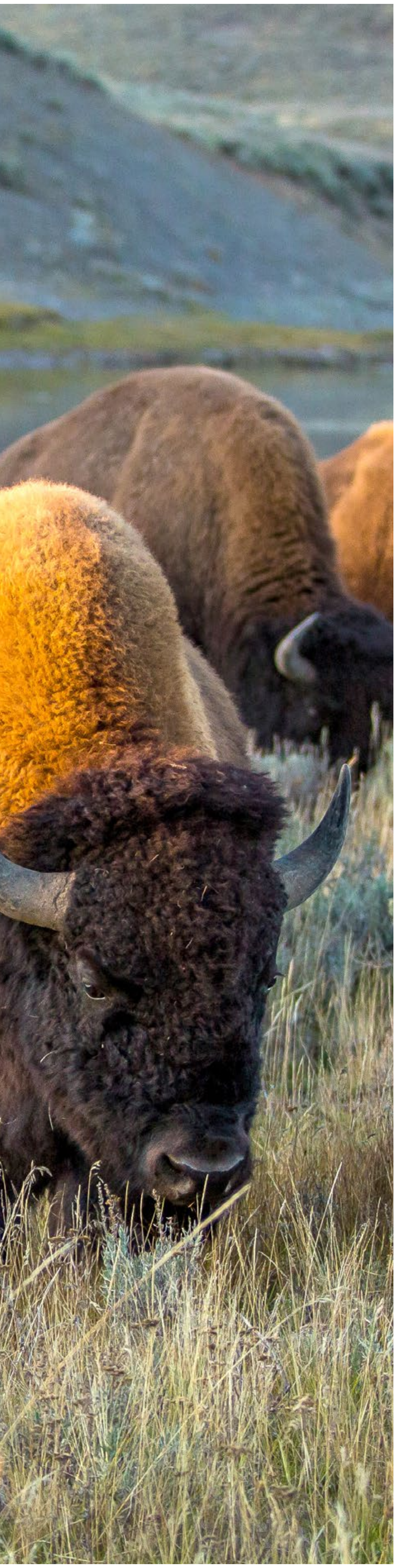
These issues mean that it is important to diversify the indicators of success in grassland management to cover also climate mitigation and other ecosystem services,** including biodiversity. This in turn will influence management approaches.

2.2 Grassland carbon sinks are threatened by inappropriate climate initiatives

The multiple benefits that grasslands supply in terms of climate change mitigation and adaptation are themselves increasingly at risk in some places due to perverse results from other climate mitigation policies and carbon markets.

Some climate change mitigation strategies are inadvertently driving grassland conversion,[67] land-grabbing and displacement of local communities. Grasslands have been seen as a better option for conversion to agricultural crops than forests, leading to greater levels of loss. Degraded grasslands,[68] savannahs[69, 70] and natural grasslands are also increasingly being mistaken for degraded forests[71] and planted with trees.[72,73] Afforestation destroys much of the SOC and grassland community composition which may take centuries to recover.[74,75] There is often confusion between *reforestation* (restoring lost forests) and *afforestation* (planting trees where there has been no recent forest cover), overestimation of carbon sequestration potential, insufficient recognition of grassland ecosystem services and the "neocolonial" tendencies of many afforestation programmes, which take little heed of local human needs.[76]

**For information on other ecosystem services from grasslands, including food and water security, disaster risk reduction, human health benefits and socio-cultural values, see From Roots to Riches, WWF, 2025



2.3 Conservation of natural grasslands and restoration of degraded grasslands

A strategy of "protect, manage, restore" can help grasslands maximise their climate mitigation potential, while co-delivering many other benefits.

Protected areas[77] and other effective area-based conservation mechanisms (OECMs or "conserved areas")[78] are key tools for maintaining natural grasslands, particularly those with wild herbivores and carnivores. In grasslands where pastoralists are operating, this can include both protected landscapes, (IUCN management category V) and grazing areas that are assessed as suitable as OECMs. These approaches are recognised under Target 3 of the Kunming Montreal Global Biodiversity Framework. Conservation needs to be planned on the large scale: connectivity is critical particularly of wide-ranging mammals[79] and the removal of linear barriers may be important.[80,81]

Restoration takes two forms: 1) creating conditions to allow natural regeneration and 2) more active planting, geoengineering or reintroductions.

The former is usually cheaper and often more effective. Both rely on future management removing or modifying the pressures that caused degradation. Changes in livestock management practices can be helpful, including changing stocking levels or introducing rotational grazing.[82] Management may involve allowing or possibly imitating natural disturbance patterns like flooding regimes[83] and, particularly, fire, although effectiveness of the latter as a restoration tool is highly context specific,[84] and should draw heavily on local knowledge. Early dry season burning can be beneficial, because fires are generally smaller and less intense than the major fires that may occur later in the season, thus leading to less emissions overall.[85] Active restoration includes dryland irrigation, use of shelter beds or earth banks, digging of half-moons (semi-circular bunds or terraces to store rainwater), and reseeding. Seed sources include commercial mixes, seeds collected from natural meadows or hay from the latter (in temperate regions),[86] or topsoil transfer, often effective in the tropics.[87] Restoration may also include rebuilding or reintroducing animal species that play a role in maintaining a healthy grassland, for example reintroduction of bison in North America is expected to significantly increase CO_2 uptake.[88]

3. RECOMMENDATIONS

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It is important to recognise grasslands as essential and stable carbon sinks and afford them greater priority in climate negotiations and inclusion into Nationally Determined Contributions (NDCs).[89]

- **Ensure that the carbon sequestration of grasslands is included where appropriate in Nationally Determined Contributions of the UNFCCC**, by drawing on the Food Forward NDCs tool[90] and using conservation, sustainable management and restoration to build secure carbon sinks.

- **Integrate grasslands across all three Rio conventions** (UNFCCC, UNCCD and the CBD), the UN Sustainable Development Goals and the UN Decade on Ecosystem Restoration:

  – Reduce and eliminate conversion of native grasslands, focusing on the most valuable grasslands from biodiversity, ecosystem service, and cultural perspectives.[91]

  – Support area-based conservation with secure long-term funding.

  – Facilitate research, monitoring and implementation of restoration projects on degraded grasslands, to recover biodiversity, ecosystem services and opportunities for sustainable use.

  – Restore large, wild herds moving over extensive, connected and diverse landscapes.

It is important to recognise grasslands as essential and stable carbon sinks and afford them greater priority in climate negotiations and inclusion into Nationally Determined Contributions (NDCs).

- **Address complex problems of both overgrazing and under-grazing**, including through removal of perverse policies and incentives where necessary.[92]

- **Develop programmes to address invasive species in grassland** in cooperation with local users, by a combination of prevention, early detection, rapid response, and targeted control.[93]

- **Remove perverse incentives for crop production or afforestation** in native grasslands. Ensure that NDCs and restoration efforts adhere to the principles of forest landscape restoration, which include no conversion of natural grasslands.

- **Support smallholder, pastoralist and transhumant communities, their culture and production systems**, through participatory land use planning, capacity building, gender-sensitive approaches, securing tenure and by integrating nomadic herding, transhumance and mobile pastoralism with other land uses. As climate conditions worsen in many areas, regularly moving livestock may itself be an increasingly important climate response.

- **Assess the economic value and benefits of grassland ecosystem services**, such as soil carbon storage, food security, climate change adaptation potential, and diversity of pollinator communities.[94]

- **Increase investment in tracking conversion:** regional monitoring programmes can identify remaining intact grasslands/habitat and conversion frontiers, so that resources can be directed to those areas, including to deter potential conversion or degradation.[95]

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Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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