Grassland Savannah Rangeland Ecosystems

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Grasslands, Savannahs and Rangelands Case Studies of Significance for Carbon and Biodiversity

Introduction

Grasslands, savannahs and rangelands (GSRs) are often perceived as storing little carbon, but their carbon stocks are considerable due to their extent globally. Unlike forests, grasslands store most of their carbon stocks underground, where carbon accumulates in the soil when plants sequester carbon dioxide from the atmosphere. Soils underlying species-rich semi-natural grasslands have a higher mean carbon density than agriculturally 'improved' grassland, arable and horticultural soils,[1,2] with a positive relationship between grassland species diversity and carbon stocks.[3,4] Natural, old growth and sparsely grazed grasslands contain 'irrecoverable carbon' that is vulnerable to land use conversion; once lost, this carbon is not recoverable over timescales relevant to current climate mitigation plans.[5] There is high potential for increasing soil carbon sequestration and stocks in grasslands through increasing plant species-richness, halting grassland conversion and degradation,[6] and better management, such as reduced or rotational livestock grazing.

The importance and potential of GSRs for global carbon storage and sequestration, and key recommendations for CBD and UNCCD policy are presented in greater detail in the companion document "The importance of grasslands, savannahs and rangelands in global climate change strategies". This document provides several case studies to provide context to the state of GSR carbon studies and projects around the world.

This is a jointly produced briefing from WWF-International and Plantlife International for country delegates at COP27.

Key Terminology

CBD: Convention on Biological Diversity
Grasslands: Ecosystems that are predominantly grass
GSRs: Grasslands, Savannahs and Rangelands
Rangelands: Either grasslands or savannahs where livestock graze
Savannahs: A mosaic ecosystem of grassland and open woodland
SOC: Soil Organic Carbon
UNCCD: United Nations Convention to Combat Desertification

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GSR Case Studies

01 North Meadows Nature Reserve, Cricklade, UK

UK grasslands are estimated to store a total of 2,097 Tg C (0-100cm).[7] Within the UK grassland types, flood plain meadows provide important habitat for biodiversity,[8] rare species[9] and ecosystem services.[10] The deep rooting and species-rich nature of floodplain meadows maximises carbon sequestration. In North Meadow National Nature Reserve, a 44 hectare floodplain in Cricklade, southern England, the mean carbon density was calculated within the top 10 cm of soil to be in the order of 10.94 kg C m^{-2}(109.4 t ha^{-1}). These values are much higher than values reported for the broad habitat of neutral grassland and extensively managed grasslands (grasslands which are not under intensive agricultural management) in a survey of grassland soil carbon.[11] Modelling research estimates that the North Meadow reserve provides countless biodiversity benefits such as sustainable hay yield, grazing services and climate regulation.[12]

A species and carbon-rich marshy grassland in the UK

02 Colombian Orinoquía

The ecosystems of the Colombian Orinoquía are highly diverse, extending from the high and eastern ranges of the Andes through to the tropical savannahs. These transition into the Amazon forest biome in the South, which is home of 4,899 plant species, 250 mammals, 1,300 birds, 119 reptiles, amphibians and around a thousand fish species.[13] The Orinoquía grasslands are critical for flood prevention[14] representing 34 per cent of the country's total wetland area. Rangelands in Orinoquía's clay soils can store more than 200 t C ha^{-1} (0-100 cm), these areas show a large potential for further soil organic carbon sequestration through better rangeland management approaches (~2.0 t C ha^{-1} yr^{-1}; 0-20 cm) making them attractive for carbon finance and mitigation.[15] Cataruben's REDD+ Orinoco2 program is reducing emissions by avoiding land use change on 3,400 hectares of private lands in Orinoquía's savannahs. Cataruben work with hundreds of landowners to develop sustainable production systems that conserve biodiversity and below ground carbon stocks.[16]

The Cerrado, Brazil, provides 40% of Brazil's freshwater and stores 13.7 billion tonnes of carbon

03 Cerrado, Brazil

The Cerrado is a tropical savanna ecoregion in Brazil. It is home to a rich diversity of beautiful landscapes, wildlife and cultures, including hundreds of traditional and indigenous peoples, whose livelihoods are dependent on biodiversity and use of the biome resources.[17] For example, the woodland root systems are deep, acting like a giant sponge that absorbs and stores rainwater, which is distributed throughout the entire year to millions of springs. It is considered the "cradle of Brazilian waters", as it provides around 40 per cent of Brazil's freshwater.[18] Only three per cent of this area is formally protected, representing an important opportunity for biodiversity and ecosystem service protection and avoided emissions: the Cerrado covers 0.2 billion ha forming a vitally important carbon stock of about 13.7 billion tonnes of carbon, two-thirds of which is underground.[19] Native grasslands store around 100 t C ha^{-1}, but almost a quarter of the Cerrado is cultivated as rangelands with African grass species, with varied carbon storage dependant on grazing regime and soil fertility.[20] When including open woodlands, the Cerrado has an average above ground biomass of 18.66 t C ha^{-1}. However, high rates of deforestation and degradation have made the Cerrado the second-largest source of carbon emissions in Brazil.[21] There have been several attempts to reduce the losses, including a voluntary moratorium on clearing for soy, and legal requirements for landowners to retain some of their property as natural vegetation, but none have been wholly successful.[22]

04 Mongolian Society for Range Management (MSRM)

The steppe grasslands of Inner Mongolia are challenged with a diverse set of stakeholder demands. These include the need for environmental services, such as increased soil carbon storage, the local herders' wish to retain traditional livelihoods while increasing their income and an increasing demand for red meat by the wider population in China and elsewhere.[23] To address these demands an initiative led by the Mongolian Society for Range Management, covering >77,000 hectares across three different sites, has created a win-win situation: optimizing income through increasing animal growth rates, which has allowed them to reduce animal stocking rates by approximately 50 per cent. This reduced livestock density, combined with moving location more regularly, not only reduces competition with grazing wildlife such as the Ibex and Mongolian gazelle, but is also allowing grasslands to recover,[24] creating over 90,000 t CO_2 of certified emissions reductions. Almost US$ 80,000 in payments for carbon sequestration were paid to 124 herding households between 2015 and 2018,[25] whilst allowing nomads to maintain their traditional livelihoods and earn more income.[26]

05 Tigray and Amhara, Ethiopia

In the arid and semi-arid grasslands of Tselemti district, north-western Tigray, Ethiopia, overgrazing is one of the most important destructive factors, causing an increase of unpalatable species as the most palatable species in the sward are eaten. Overgrazing can cause reduced plant cover, biomass and diversity, which then increases soil erosion, greenhouse gas emissions and reduces the overall productivity of the land.[27] Ten years of grazing exclosures (excluding livestock from certain degraded communal grazing lands) has led to the recovery of plant species richness, forage and wood production, and soil health, and, thus, helped to improve the supply of ecosystem services prioritized by local stakeholders.[28] Here, carbon stocks and soil nutrients have increased with length of exclusion time: total carbon stock was 55.06 t C ha^{-1} at five years ex-closure, while ten year exclosure saw a 37 per cent increase in soil carbon (75.65 t C ha^{-1}). In comparison, the ten-year exclosure had nearly twice as much soil carbon stock of open grazing areas (51.98 t C ha^{-1}).[29]

06 Northern Kenya Carbon Project

The Northern Kenya Carbon Project (NKCP) is the world's first large-scale grasslands soil carbon project. It is one of the few large, landscape-level carbon removal ventures currently on the market.[30] Spanning 1.9 million hectares, it is anticipated to remove and store 50 million tons of CO_2 over 30 years – the equivalent of the annual emissions from over ten million cars. The project also improves habitats for four endemic and endangered species (the Eastern black rhino, Grevy's zebra, Reticulated giraffe and Beisa oryx). The Northern Rangelands Trust (NRT) is partnered with community-owned conservancies, where grasslands are grazed and managed sustainably, to verify and sell grassland carbon sequestration credits from the NKCP on the international voluntary carbon market. In 2010, NRT partnered with Soils for the Future scientist, Dr Mark Ritchie, to demonstrate that the NKCP's better grazing management resulted in higher carbon stored in the soil. By 2018, 14 community conservancies had given NRT permission to sell their soil carbon and by 2020, Verra had certified the NKCP as meeting Verified Carbon Standards (VCS). NRT are now selling 3.2 million VCS credits on the voluntary carbon market.[31]

A Samburu pastoralist grazing cattle sustainably in the savannah rangelands of the Northern Kenya Carbon Project

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