U.S. Grasslands Regeneration

Grasslands-based projects are playing an increasingly important role in carbon sequestration and biodiversity preservation across the United States, and they blend building landscape resilience and adaptability with real-world economics.

At a glance

01 Grasslands cover 40% of the world's land area[1] and store more than 30% of its terrestrial carbon.[2]

02 Grasslands once covered about half of the landmass of the 48 contiguous states, or about one billion acres / 404 million hectares.[3]

03 Due to mass conversion to agricultural land, unsustainable agricultural practices, desertification, and other hazards, half of global grasslands have been degraded[4], drastically reducing their capacity to provide climate, ecosystem, and social benefits.

04 Some 70 percent of the U.S.'s tallgrass, mixed-grass and shortgrass prairies have been converted to agricultural use or otherwise altered to the point their capacity to provide climate, ecosystem, and social benefits is drastically reduced.[5]

05 **Global grasslands account for nearly a quarter (4.9 million km^2) of Key Biodiversity Areas (KBAs).[6]**

---

[1] Hewins, D.B., Lyseng, M.P., Schoderbek, D.F., et al., 2018. Grazing and climate effects on soil organic carbon concentration and particle-size association in northern grasslands. Scientific Reports, 8, p.1336. Available at: https://doi.org/10.1038/s41598-018-19785-1

[2] Hewins, D.B., Lyseng, M.P., Schoderbek, D.F., et al., 2018. Grazing and climate effects on soil organic carbon concentration and particle-size association in northern grasslands. Scientific Reports, 8, p.1336. Available at: https://doi.org/10.1038/s41598-018-19785-1

[3] Texas A&M Natural Resources Institute. (2017). Conserving the future: An economic and ecological perspective on the U.S. grasslands. Texas A&M University System. Retrieved from https://nri.tamu.edu/media/1101/us_grasslands.pdf

[4] Yan, Z., Gao, Z., Sun, B., Ding, X., Gao, T. & Li, Y., 2023. Global degradation trends of grassland and their driving factors since 2000. International Journal of Digital Earth, 16(1), pp.1661–1684. Available at: https://doi.org/10.1080/17538947.2023.220784

[5] O'Neill, B. C., & Polasky, S. (2013). Groundwater, climate change, and agriculture: An analysis of economic impacts and adaptation strategies. CARD Working Paper Series. Center for Agricultural and Rural Development (CARD) at Iowa State University.

[6] Key Biodiversity Areas. (n.d.). Key Biodiversity Areas data. Retrieved December 10, 2024, from https://www.keybiodiversityareas.org/kba-data

06 In the United States alone, ecosystem pollination services provided by pollinators in grassland habitats is valued at more than $3 billion annually.[7]

07 Grasslands regeneration and preservation projects can produce a variety of options for financial returns, including eco-tourism and recreation, land value appreciation, and ecosystem services payments.

08 Grasslands regeneration projects represent an opportunity for impact investors to reverse environmental degradation while also making a significant financial return.

09 Investing in or purchasing carbon credits from grasslands regeneration projects offers flexibility for meeting regulatory requirements or voluntary sustainability goals, while also boosting public image through a demonstrated commitment to sustainability.

Overview

The United States' Great Plains evoke romantic visions of immense herds of bison, smoke rising from teepees in Native villages, covered wagons rolling through rutted tracks, and seemingly infinite "amber waves of grain." These types of undeveloped grasslands once covered about half of the landmass of the current 48 contiguous states, or about one billion acres / 404 million hectares.[8]

This landscape was and is home to boundless biodiversity, and it provides immense ecosystem services in the form of filtering and storing water, maintaining and enhancing soil fertility, supporting the existence and productivity of crucial pollinating insects, reducing surface water runoff and preventing floods, filtering and cleaning the air, and sequestering carbon to help maintain a stable climate.

Globally, grasslands cover 40% of the world's surface and store more than 30% of its terrestrial carbon.[9] They provide resilience in the face of increasing droughts and heatwaves; they're home to countless species of plants and animals; and they're essential to the livelihoods and food security of communities around the world.

[7] Losey, J. E., & Vaughan, M. (2006). The economic value of ecological services provided by insects. BioScience, 56(4), 311–323. https://doi.org/10.1641/0006-3568(2006)56[311:TEVOES]2.0.CO;2

[8] Texas A&M Natural Resources Institute. (2017). Conserving the future: An economic and ecological perspective on the U.S. grasslands. Texas A&M University System. Retrieved from https://nri.tamu.edu/media/1101/us_grasslands.pdf

[9] Grasslands, Rangelands, Savannahs and Shrublands (GRaSS) Alliance (2023). Valuing Grasslands: Critical Ecosystems for Nature, Climate and People. Discussion Paper, December 2023. Dragonfly Advisory. Available at: https://www.birdlife.org/wp-content/uploads/2023/12/Valuing-Grasslands-Report-Dec-2023.pdf

Unfortunately, due to mass conversion to agricultural land, unsustainable agricultural and grazing practices, desertification, and other hazards, grasslands are some of the most-threatened ecosystems on Earth. In fact, half of global grasslands have been degraded, drastically reducing their capacity to provide climate, ecosystem, and social benefits.

In the United States, the situation is equally dire; since 2012, more than 32 million acres of rangeland in the Great Plains have been converted to other land uses like croplands, disrupting critical wildlife habitat and migration corridors.[10]

In spite of this, the current state of U.S. grasslands presents an opportunity. Due to their crucial role in carbon sequestration and biodiversity preservation, and the way they incorporate building landscape resilience with real-world economics and financial security, grasslands regeneration projects are an effective, durable, and crucial natural solution.

Grasslands: An important carbon sink

Atmospheric CO_2 is absorbed by plants through the process of photosynthesis. This carbon is then stored in plant biomass, including leaves, stems, and roots, or is transferred into the soil through the roots. Like forests, grasslands fix carbon from the atmosphere into aboveground organic material. But the vegetation found on grasslands sequesters 90% of its carbon not above-ground, but in deep roots and soil organic carbon (SOC), a fact that has given them the nickname "inverted forests." And the world's inverted forests have the potential to sequester up to 7.3 billion metric tons[11] of CO_2e annually.

[10] World Wildlife Fund. (2024). Plowprint Report 2024. World Wildlife Fund. https://files.worldwildlife.org/wwfcmsprod/files/Publication/file/8mq6fdcmt4_PlowprintReport_2024_FINAL.pdf

[11] Bai, Y. & Cotrufo, M.F., 2022. Grassland soil carbon sequestration: Current understanding, challenges, and solutions. Science, 377(6606), 603-608. https://doi.org/10.1126/science.abo2380

What is SOC, and how does it contribute to maintaining healthy ecosystems?

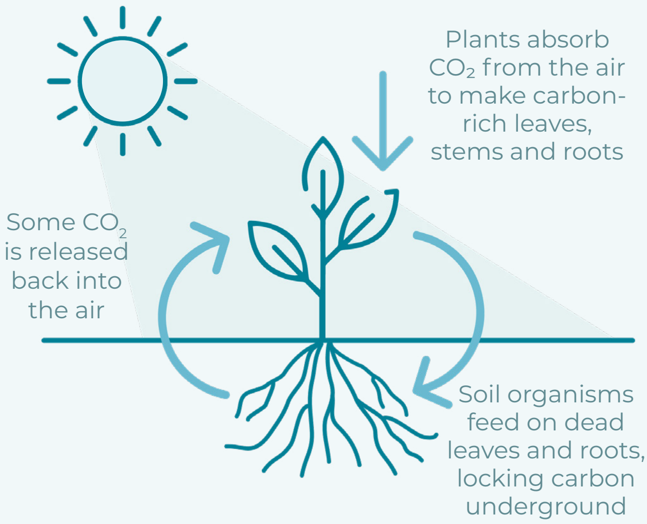
Soil organic carbon (SOC) is the carbon component of organic compounds found in soil organic matter (SOM), which includes a mixture of organic compounds including living organisms like plant roots and soil fauna like microbes, earthworms, snails, and insect larvae; decomposing plant and animal matter; and humus - fully decomposed organic matter.

SOC plays a significant role in maintaining soil health, fertility, and structure; enhances the availability of nutrients; and acts as a carbon sink to mitigate greenhouse gasses.

SOC is created via natural processes of vegetation lifecycles, including:

1. **Photosynthesis:** Plants — including grasses — absorb carbon dioxide from the atmosphere during the process of photosynthesis, the biological process through which they convert light energy into chemical energy to fuel their growth and other activities.
2. **Root systems:** Plants' root systems contribute to SOC creation via the secretion of exudate fluids that inhibit harmful microbes and promote growth, encourage microbial interactions that break down organic matter, and – when they decay – add organic matter to the soil. These roots continuously grow, die, and decompose, contributing substantial organic matter below ground.

How soil stores carbon



What is carbon permanence?

Carbon permanence refers to the duration that carbon remains stored without being released back into the atmosphere as carbon dioxide.

Healthy grasslands are well equipped to serve as highly permanent carbon sinks because of their comparative resilience in the face of natural disasters, and their ability to regenerate quickly in the event of ecosystem damage.[12] Grasslands are resilient, keeping carbon protected from disturbances, usually in the form of humus, a stable form of organic carbon that can remain in the soil for decades or even centuries.

Ecosystem regeneration projects with high levels of carbon permanence often generate higher-quality carbon credits and give investors confidence that carbon credits generated from these projects will retain their value. Furthermore, by supporting projects that ensure carbon permanence, organizations can demonstrate their commitment to sustainability and responsible environmental management.

And because demonstrating carbon permanence requires rigorous monitoring, reporting, and verification processes, highly permanent carbon projects often achieve high levels of transparency and accountability, key concerns for project investors, offtakers, and carbon verification bodies.

[12] Dass, P., et al., 2018. Grasslands may be more reliable carbon sinks than forests in California. Environmental Research Letters, 13, 074027

The economic value of U.S. grasslands

The purely economic value of U.S. grasslands is immense, as these ecosystems are essential for agricultural, grazing livestock, producing forage, and supporting rural economies. In the United States, grasslands are a cornerstone of the beef industry, with rangelands and pasturelands providing critical grazing resources.

But the value of U.S. grasslands' ecosystem services may dwarf their commonly understood value as "America's Breadbasket"; research has shown that the annual economic value of grassland ecosystem services ranges from $1,600 to $2,211 per acre / $3,955 to $5,466 per hectare.[13]

In terms of biodiversity, global grasslands account for nearly a quarter (4.9 million km2) of Key Biodiversity Areas (KBAs). They're home to a diverse range of plants and animals – including crucial pollinators – and many endangered and threatened species. In the United States alone, these pollination services are valued at more than $3 billion annually. [14]

[13] Liu, H., Hou, L., Kang, N., Nan, Z., & Huang, J. (2022). The economic value of grassland ecosystem services: A global meta-analysis. Grassland Research, 1(1), 63–74.

[14] Losey, J. E., & Vaughan, M. (2006). The economic value of ecological services provided by insects. BioScience, 56(4), 311–323. https://doi.org/10.1641/0006-3568(2006)56[311:TEVOES]2.0.CO;2

Saving the monarch

For millennia, millions of monarch butterflies migrated thousands of miles across North America, heading south to the mountain forests of Mexico in the fall, and north to the grasslands and prairies of Canada and the United States in the spring. Within these grasslands grew Asclepias, a plant commonly called milkweed, the sole "host plant" for monarchs; monarch caterpillars only eat milkweed, and it's also the only plant on which the species lays its eggs.[15]

To most species of birds and animals – including humans – milkweed is toxic. But the monarch and other insects adapted to the toxin in milkweed and used it as a defense. When ingested, chemicals within milkweed made the insects – including many species of butterflies, moths, bees, and other crucial pollinators – undesirable in taste and possibly even poisonous to predators.[16]

During the 19th and 20th centuries, vast expanses of North American grasslands were developed for agricultural use, largely destroying the native ecosystems, including monarch butterfly breeding habitat where milkweed naturally thrived. More recently, the use of herbicide-resistant genetically modified crops and significantly increased herbicide applications further diminished the presence of milkweed on agricultural fields where it once coexisted with crops.[17]

As a consequence, monarch butterfly populations across North America plummeted; the western monarch population declined by more than 90 percent over the past three decades.[18] Numbering some 1.2 million in the 1990s, the western population now hovers around 200,000 butterflies. In response to this alarming decline, in December of 2024, U.S. wildlife officials announced a decision to extend federal protections to the species, and plans to add it to the Threatened Species list in 2025.[19]

The regeneration of degraded grasslands and the restoration of milkweed within those ecosystems is a crucial tool in the effort to save the monarch butterfly and numerous other crucial pollinators, whose populations are also rapidly declining.

---

[15] Hansen, T. E., & Enders, L. S. (2022). Host plant species influences the composition of milkweed and monarch microbiomes. Frontiers in Microbiology, 13, Article 840078. https://doi.org/10.3389/fmicb.2022.840078

[16] Groen, S. C., et al. (2021). Convergent evolution of cardiac-glycoside resistance in predators and parasites of milkweed herbivores. Current Biology, 31(22), R1465–R1466. https://doi.org/10.1016/j.cub.2021.10.025

[17] Pleasants, J. M., & Oberhauser, K. S. (2012). Milkweed loss in agricultural fields because of herbicide use: Effects on the monarch butterfly population. Insect Conservation and Diversity, 16(2), 135–144. https://doi.org/10.1111/j.1752-4598.2011.00142.x

[18] Schultz, C. B., Brown, L. M., Pelton, E., & Crone, E. E. (2017). Citizen science monitoring demonstrates dramatic declines of monarch butterflies in western North America. Biological Conservation, 214, 343–346. https://doi.org/10.1016/j.biocon.2017.08.019

[19] U.S. Fish and Wildlife Service. (2024, December). Monarch butterfly proposed for Endangered Species Act protection. Retrieved December 12, 2024, from https://www.fws.gov/press-release/2024-12/monarch-butterfly-proposed-endangered-species-act-protection

Grasslands also play a crucial role in terms of soil health and water regulation. The soil of temperate grasslands is deep, dark, and nutrient-rich from the growth and decay of deep grass roots, which hold the soil together and prevent erosion. These roots also absorb large quantities of water, reducing runoff, flooding, and erosion, and also boosting drought resistance.

(In sum, the annual economic value of global grasslands ecosystem services is estimated to exceed $20.8 trillion.[20])

Healthy grasslands' rich, moist soil is perfect for agriculture, which is why roughly 20% of the world's temperate grasslands[21] have been converted for agricultural use.

Unfortunately, typical modern grazing practices destroy grasslands' native vegetation, damage soils, and disrupt natural processes; when livestock overgrazes on the same area to the point they chew grasses down to the ground and even extract the roots, they kill the plants and erode the soil.

Timeless regeneration activities for the modern age

Even as poor livestock management is detrimental to the landscape, large herbivores have always been crucial to the health of grasslands ecosystems. Present on grasslands for millions of years, their movement and grazing contributed to the natural function of these biomes in ways we're only now beginning to understand.

The American bison is a perfect example: When enormous herds of hundreds of thousands of bison roamed North America's Great Plains, they ate as they went, mowing the grass down to the sheath. Then they moved on, sometimes not returning for many years, allowing grasses to recover and send up new shoots. And because they were always on the move, instead of compacting the soil, the bison's hooves broke it up and gave vegetation a chance to take root. Additionally, their broadly scattered waste acted as a natural fertilizer. These activities were duplicated by wild ruminants on grasslands around the world.

Rotational grazing – sometimes called holistic grazing – imitates the actions of these wild herbivores by continually moving herds of domesticated animals to new areas and giving grazed off vegetation a chance to recover and grow. The ever-deepening roots of these plants boost soil biomass and fertilize the ground by isolating carbon from the atmosphere. And the cycle goes on.

This application of rotational grazing means grasslands regeneration projects can promote soil health, biodiversity, and ecosystem function while also creating jobs, enhancing food security, and strengthening local economies.

[20] Liu, H., Hou, L., Kang, N., Nan, Z., & Huang, J. (2022). The economic value of grassland ecosystem services: A global meta-analysis. Grassland Research, 1(1), 63–74.

[21] O'Mara, F. P. (2012). The role of grasslands in food security and climate change. Annals of Botany, 110(6), 1263–1270. https://doi.org/10.1093/aob/mcs209

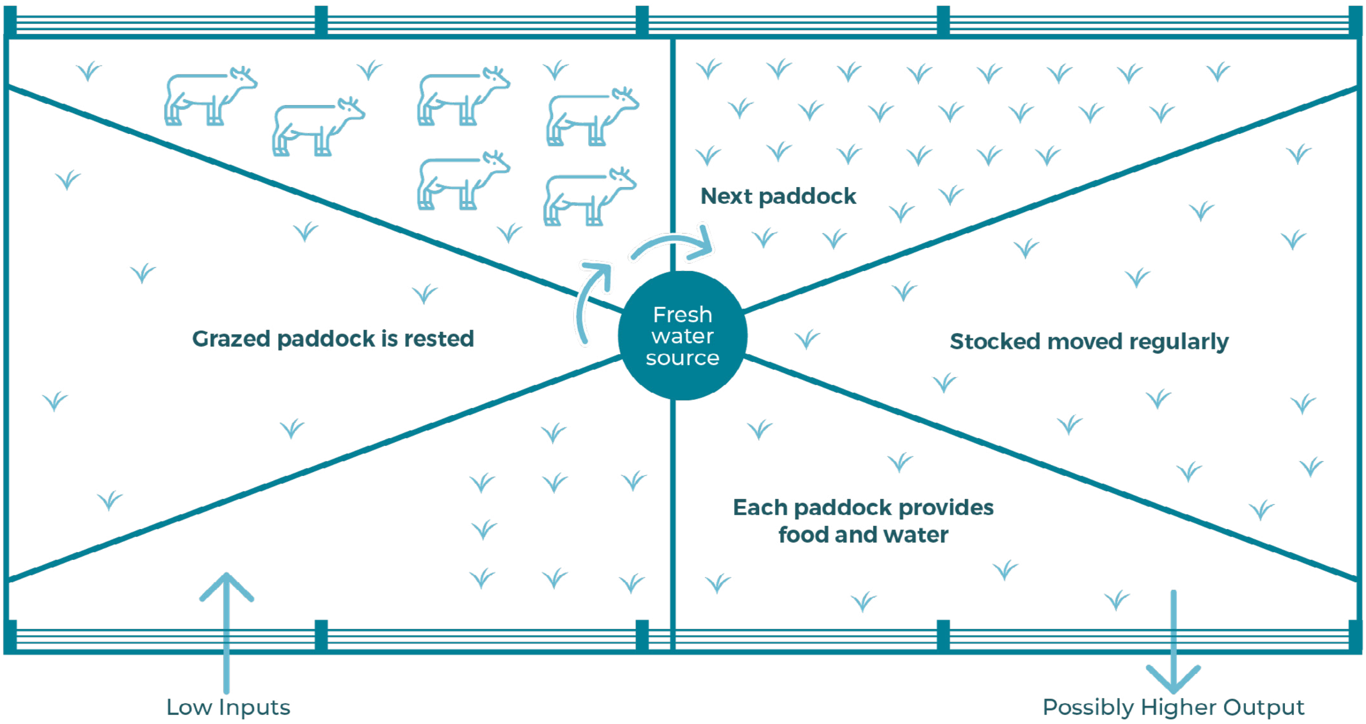
How rotational grazing mitigates livestock methane emissions

Ruminants, especially cattle, produce methane as a byproduct as they digest their food, through a process called enteric fermentation. While methane emissions can't be entirely eliminated from animal agriculture, adopting rotational grazing practices can help reduce overall emissions. Rotational grazing improves the quality of forage, which is easier for livestock to digest, potentially leading to a reduction in methane emissions compared to traditional continuous grazing systems.

Furthermore, rotational grazing helps to manage manure in a more sustainable way by distributing it more evenly over the land, which reduces the concentration of manure in specific areas. In conventional grazing, manure often accumulates in large quantities in one area.[22] Storing manure in liquid form in lagoons, tanks, or pits — common practice in the industrial livestock industry — produces significant methane due to the anaerobic conditions that are created. But manure that is distributed across the landscape through rotational grazing produces far less methane and improves soil health by returning nutrients directly to the soil.

In all of Cultivo's grasslands regeneration projects, methane emissions are accounted for within carbon credit methodologies, including those under Verra's Verified Carbon Standard (VCS).

Simple Rotational Grazing



[22] Bosch, D.J., 2008. Journal of Soil and Water Conservation, 63(2), p.51A. https://doi.org/10.2489/jswc.63.2.51A

The investment opportunity of grasslands regeneration projects

Beyond rotational grazing, which generates a return as a form of agriculture, grasslands regeneration and preservation projects can produce a variety of options for financial returns, including eco-tourism and recreation, land value appreciation, and ecosystem services payments. (Payments for ecosystem services [PES] are payments to land stewards or landowners who have agreed to take certain actions to manage their land to provide an ecological service, which is any positive benefit that wildlife or ecosystems provide to people: providing drinking water, preventing erosion, providing habitat for crucial pollinators, and – perhaps most well known and most broadly accepted – sequestering carbon.)

Because of this, grasslands regeneration projects represent an opportunity for impact investors to help in the fight against environmental degradation while also earning a significant financial return. In fact, according to the World Resources Institute, every dollar invested in nature restoration activities provides an estimated $7-30 return[23] in economic benefits.

Additionally, the cost-effectiveness of grasslands projects holds distinct investment appeal; they typically involve lower implementation and maintenance costs than other carbon sequestration projects, with long-term ecological and economic benefits outweighing initial investments.

INVESTOR CASE STUDY
Octopus Energy Generation

Octopus Energy Generation's fund management team is one of Europe's largest specialist investors in renewables and energy transition technologies. Octopus Energy Generation invests throughout the life cycle of green energy projects, including in developers creating new green projects, to construction and operational ones too. As part of this work, Octopus Energy Generation invests in businesses that are creating green infrastructure investment opportunities and then finance those infrastructure projects too, and in a sense, natural capital projects with certain features can be considered 'infrastructure investment.'

Octopus Energy Generation partnered with Cultivo to develop a pipeline of high-quality natural capital projects, using cutting-edge technology to ensure these will help the natural environment flourish and provide meaningful benefits to local communities that host them.

In the United States, Octopus Energy Generation's investment is funding the regeneration of thousands of hectares of grasslands and their naturally fertile soils through a variety of regeneration grazing practices, such as adaptive multi-paddock grazing or high-density short-duration grazing. All grazing practices are designed to balance social, environmental, and financial considerations.

[23] Ding, H., Farqui, S., Wu, A., Altamirano, J.C., Ortega, A.A., Verdone, M., Cristales, R.Z., Chazdon, R. & Vergara, W., Roots of Prosperity: The Economics and Finance of Restoring Land. World Resources Institute.

Carbon removal credits from grasslands regeneration projects

Grasslands regeneration projects improve biodiversity, water retention, and resistance to erosion, and support overall ecosystem resilience. They also contribute to the removal of CO_2 from the atmosphere, which means they can produce carbon removal credits, certificates that businesses can use to help to offset their greenhouse gas emissions.

For offtakers, the benefits of purchasing carbon credits from grasslands regeneration projects are numerous. Significant carbon sinks, grasslands effectively store carbon in both plant biomass and soil, with a lower risk of reversal compared to forests. Regenerating grasslands also preserves critical habitats, promoting biodiversity and providing essential ecosystem services such as water filtration and soil stabilization. Grasslands regeneration projects support local communities by providing jobs and fostering sustainable agricultural practices, improving food security and livelihoods. And they enhance nature's resilience by improving soil health and increasing water retention, reducing the impacts of extreme weather events.

Purchasing carbon removal credits from grasslands regeneration projects also offers significant co-benefits to businesses working to burnish their sustainability credentials and meet their climate goals. Beyond the immediate environmental impact, buying carbon removal credits also drives the adoption of sustainable land management practices, fostering a more sustainable supply chain. Supporting grasslands regeneration projects also promotes technological advancements in soil monitoring and verification, ensuring the credibility and effectiveness of future carbon sequestration projects and the credits they produce. And companies that purchase these carbon removal credits are contributing to the advancement of soil health, which enhances landscape resilience and productivity.

About Cultivo

Cultivo and project partners work on ecosystem regeneration projects across the globe, including numerous projects focused on grasslands regeneration and preservation. If you're interested in learning more about grasslands regeneration projects, building a portfolio of high-quality natural capital projects for investment, or accessing high-integrity nature based carbon removal credits with Cultivo, we invite you to get in touch with our team.

SCHEDULE A MEETING!