Soil Carbon Drawdown Numbers for Regenerative Grazing - A Soil4Climate Technical Brief

Per Hectare Soil Carbon Drawdown Numbers and CO_2 Equivalents via Improved Grazing, and Globally by All Means

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Overview

Six studies since 2016 of improved grazing management measured soil carbon accrual rates ranging from 2 to 3.59 tC/ha/yr (to 1 meter) giving an average accrual of 2.73 tC/ha/yr with a corresponding CO2e drawdown of 10.02 tCO2e/ha/yr. Management types included Holistic Planned Grazing, Adaptive Multi-paddock “AMP” Grazing, multi-species pasture rotation (MSRP), and “rotational grazing system with improved grass pasture species.”

Highlights

- Teague (2016) calculates the potential drawdown for North American pasturelands is 800 million tonnes of carbon per year (800 MtC/yr), or 0.8 gigatons of carbon per year (0.8 GtC/yr). Based 263 million hectares of North American pastureland and drawdown potential of 1.2 tC/ac/yr. There are approximately 3.3 billion hectares of pastureland worldwide (UN FAO 2020).

- Johnson (2022) calculates that if AMP grazing were applied over 1.25 billion hectares of savannahs and grasslands globally, the increased photosynthetic capacity and decreased soil C respiration would remove 9.82 and 6.66 billion tonnes CO2 year−1 or 26.8% and 18.19% respectively of the global 36.6 billion tonnes of global anthropogenic emissions. Johnson (2022) also shows that AMP stocking density can be 2.38 times higher than conventional grazing systems.

- Lal (2020) estimates that between 2020 and 2100, soils globally can sequester 178 PgC, or 178 GtC. (Thus, averaging 2.25 GtC/yr).

Note: 1 petagram (Pg) = 1 gigaton (Gt)

Rates and Publications by Year

Rate: 2 tC/ha/yr (0–20cm)
Location: La Primavera municipality, Vichada, Colombia
Notes: “improve grasslands (IG) pursuing a sustainable intensification, such as a rotational grazing system with improved grass pasture species”
Source: Costa (2022)

Rate: 2.07 tC/ha/yr to 1m (based on 20% SOM increase in Adaptive Multi-paddock - AMP - grazing paddocks to 10 cm. 1 m estimate made by Soil4Climate.)
Location: Mississippi, Alabama, Tennessee and Kentucky
Notes: Comparison of Adaptive Multi-paddock (AMP) grazing to Continuous Grazing (CG)
Source: Johnson (2022)

Rate: 2.29 tC/ha/yr (0.93 tC/ac/yr)
Location: Clay County, Georgia, USA
Notes: “multispecies pasture rotation (MSPR) … holistic planned grazing methodology”
Source: Rowntree (2020)

Rate: 2.1 tC/ha/yr (0.85 tC/ac/yr)
Location: Corrientes Province, Argentina
Notes: conversion from continuous grazing to Holistic Management
Source: Kurtz (2020)

Rate: 3.59 tC/ha/yr (1.5 tC/ac/yr)
Location: Missaukee County, Michigan, USA
Notes: “AMP grazed pastures”
Source: Stanley (2018)

Rate: 3 tC/ha/yr (1.2 tC/ac/yr) (top 90cm)
Location: Cooke, Parker and Jack counties, Texas, USA
Notes: Adaptive Multi-paddock (AMP) grazing
Source: Teague (2016)

Table Format, Publication Listings by Year

C Rate tC/ha/yr	**CO2 Rate** tCO2/ha/yr	**Location**	**Source**	**Notes**
2.00	7.23	La Primavera municipality, Vichada, Colombia	Costa (2022)	"improve grasslands (IG) pursuing a sustainable intensification, such as a rotational grazing system with improved grass pasture species"
2.07	7.6	Mississippi, Alabama, Tennessee and Kentucky	Johnson (2022)	based on 20% SOM increase in Adaptive Multi-paddock (AMP) grazing paddocks to 10 cm. 1 m estimate made by Soil4Climate.
2.29	8.4	Clay County, Georgia, USA	Rowntree (2020)	"multispecies pasture rotation (MSPR) … holistic planned grazing methodology"
2.10	7.71	Corrientes Province, Argentina	Kurtz (2020)	conversion from continuous grazing to Holistic Management
3.59	13.8	Missaukee County, Michigan, USA	Stanley (2018)	"AMP grazed pastures"
3.00	11.01	Cooke, Parker and Jack counties, Texas, USA	Teague (2016)	Adaptive Multi-paddock (AMP) grazing
AVG: 2.73 tC/ha/yr = 10.02 tCO2e/ha/yr				

References

Costa et al. 2022, Soil carbon stocks and nitrous oxide emissions of pasture systems in Orinoquía region of Colombia: Potential for developing land-based greenhouse gas removal projects, Frontiers in Climate, vol 4, 2022, 10.3389/fclim.2022.916068,
https://www.frontiersin.org/articles/10.3389/fclim.2022.916068/full

Johnson DC, Teague R, Apfelbaum S, Thompson R, Byck P. 2022. Adaptive multi-paddock grazing management's influence on soil food web community structure for: increasing pasture forage production, soil organic carbon, and reducing soil respiration rates in southeastern USA ranches. PeerJ 10:e13750
https://peerj.com/articles/13750/

Lal, R (2020) *Managing soils for negative feedback to climate change and positive impact on food and nutritional security*, Soil Science and Plant Nutrition, 66:1, 1-9, DOI: 10.1080/00380768.2020.1718548.
https://doi.org/10.1080/00380768.2020.1718548

Rowntree JE, Stanley PL, Maciel ICF, Thorbecke M, Rosenzweig ST, Hancock DW, Guzman A and Raven MR (2020) *Ecosystem Impacts and Productive Capacity of a Multi-Species Pastured Livestock System*. Front. Sustain. Food Syst. 4:544984. doi: 10.3389/fsufs.2020.544984
https://www.frontiersin.org/articles/10.3389/fsufs.2020.544984/full

Kurtz, D. et al. (2020) *Impacto Del Pastoreo En Propiedades Fisico-Quimicas De Un Psammacuent En Pastizales Del Nordeste Argentino* (The impact of grassland management on physical and chemical properties of a sandy soil in northeastern Argentina). Revista Argentina de Produccion Animal VOL 40 N° 2: 1-13 (2020) https://www.crea.org.ar/wp-content/uploads/2021/10/2020-PP-Kurtz-Ditmar-y-otros.pdf

Stanley, P. L., Rowntree, J. E., Beede, D. K., DeLonge, M. S., & Hamm, M. W. (2018). *Impacts of soil carbon sequestration on life cycle greenhouse gas emissions in Midwestern USA beef finishing systems.* Agricultural Systems, 162, 249-258.
https://www.sciencedirect.com/science/article/pii/S0308521X17310338?via%3Dihub

Teague, W. R., Apfelbaum, S., Lal, R., Kreuter, U. P., Rowntree, J., Davies, C. A., R. Conser, M. Rasmussen, J. Hatfield, T. Wang, F. Wang, Byck, P. (2016). *The role of ruminants in reducing agriculture's carbon footprint in North America*. Journal of Soil and Water Conservation, 71(2), 156-164. doi:10.2489/jswc.71.2.156 http://www.jswconline.org/content/71/2/156.full.pdf+html

UN FAO (Food and Agriculture Organization of the United Nations). 07, May, 2020, Sustainable Agriculture, Land use in agriculture by the numbers.
https://www.fao.org/sustainability/news/detail/en/c/1274219/

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