Carbon Farming:Toward a Climate-Beneficial and Resilient Agriculture

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What is Carbon Farming?

Engaging agriculture as a climate solution through the beneficial transfer of atmospheric carbon to working land soils and vegetation.

Managing the farm system for increased photosynthesis, increased cycling and storage of carbon and reduced emissions of other GHG.

Building agroecological resilience and other ecosystem functions and services.

Historic and current land management has led to significant loss of organic carbon from global ecosystems

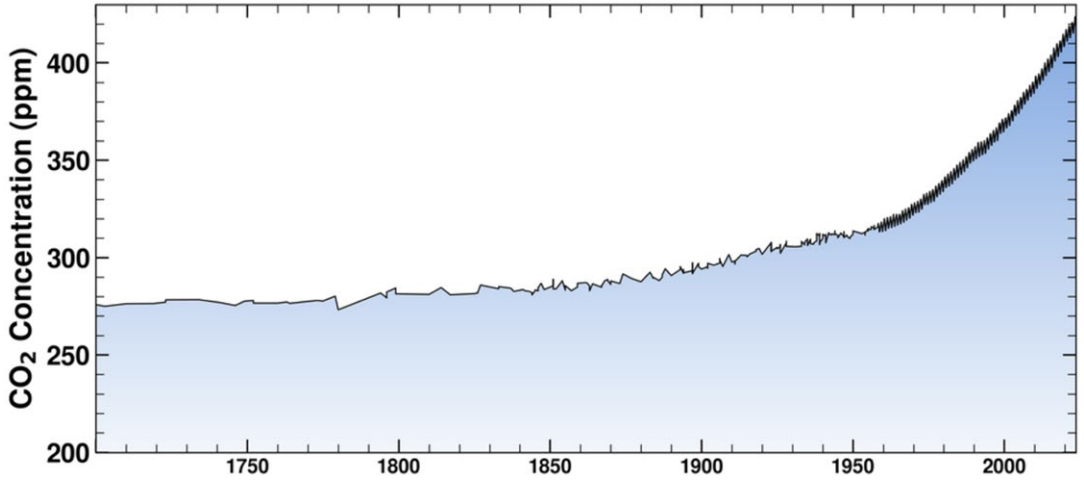

Iowa State University 2002.


Fordyce, NE. May 12, 2022. Photo: V. Affatati.

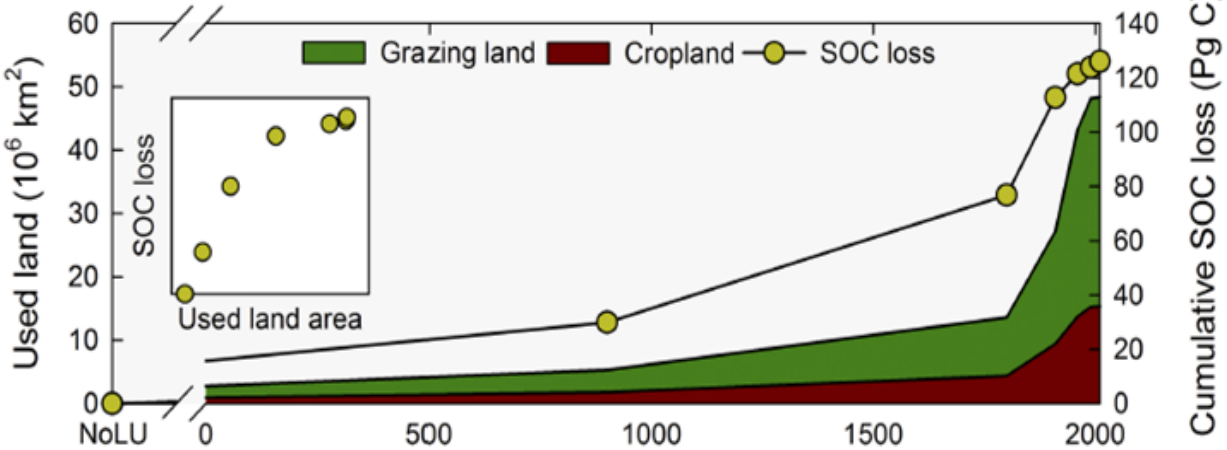
DW 2022.


Frontier Ag 2017

Scripps Institution of Oceanography 20224



Sanderman et al. 2017



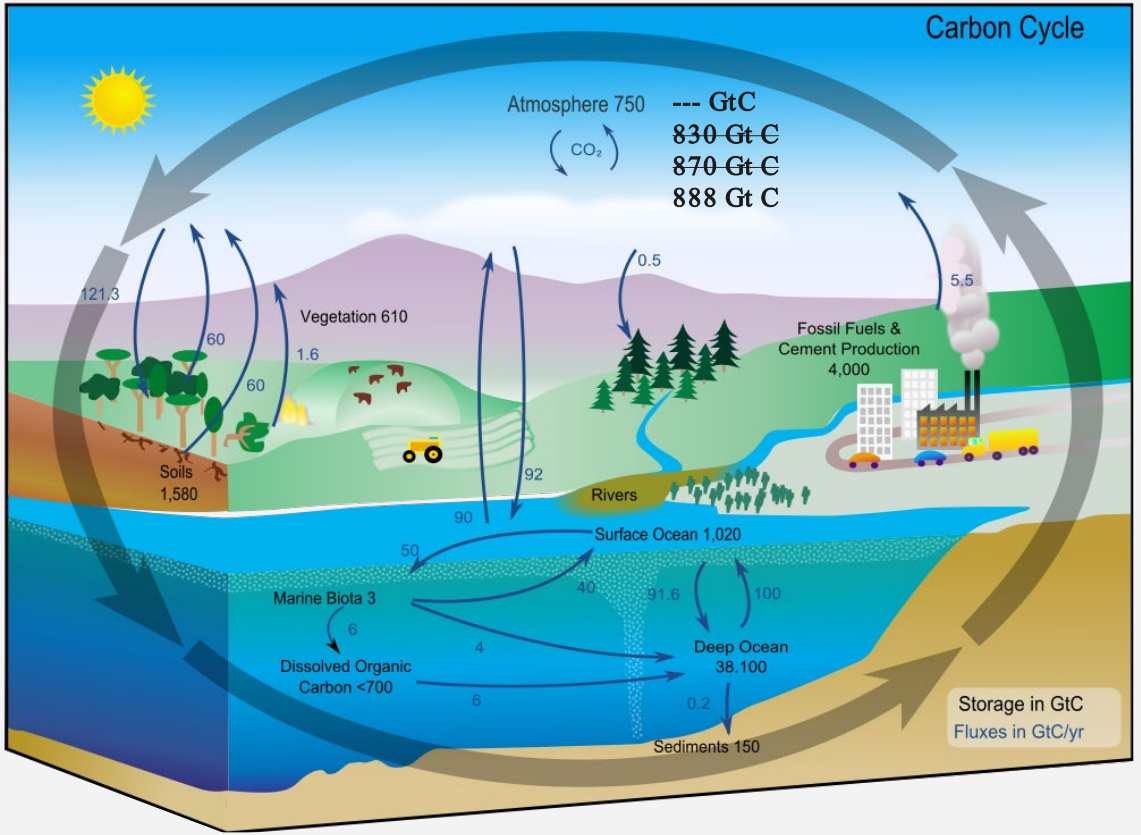
Global carbon debt due to agriculture of 133 Pg C for the top 2 m of soil, equal to ~27% of the CO_2 emitted from human sources since 1750.

Carbon Cycle

Photosynthesis:
the transformation of solar radiation into biochemical energy

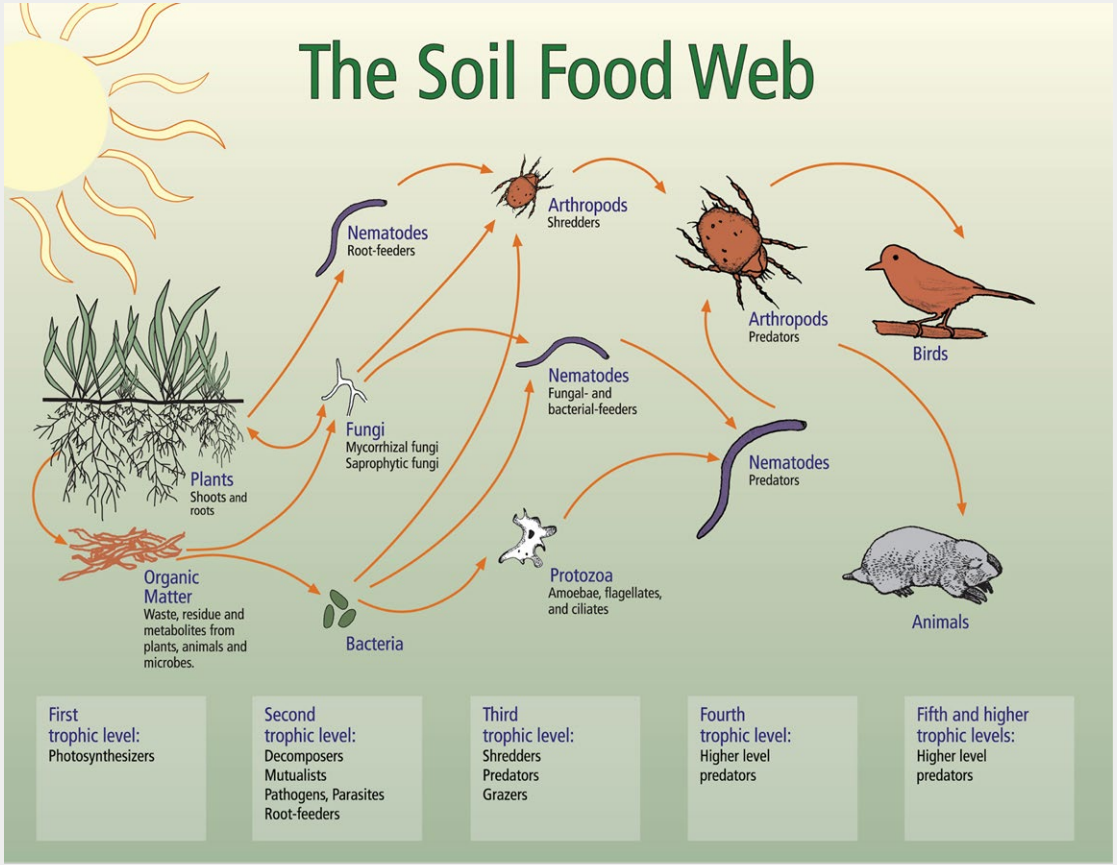
Carbon, drawn from the air through the process of photosynthesis, embodies the solar energy used by primary producers (plants) to drive the process.

Carbon is thus the energy currency of living systems, including farm systems and farm system processes.



Recarbonizing the Biosphere: Managing the flow of solar energy through the farm system

Carbon Farming manages for increased photosynthesis and transformation of solar energy into soil organic matter, soil fertility, farm production and the cascade of energy that flows through the entire farm ecosystem.



https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/biology/?cid=nrcs142p2_053868

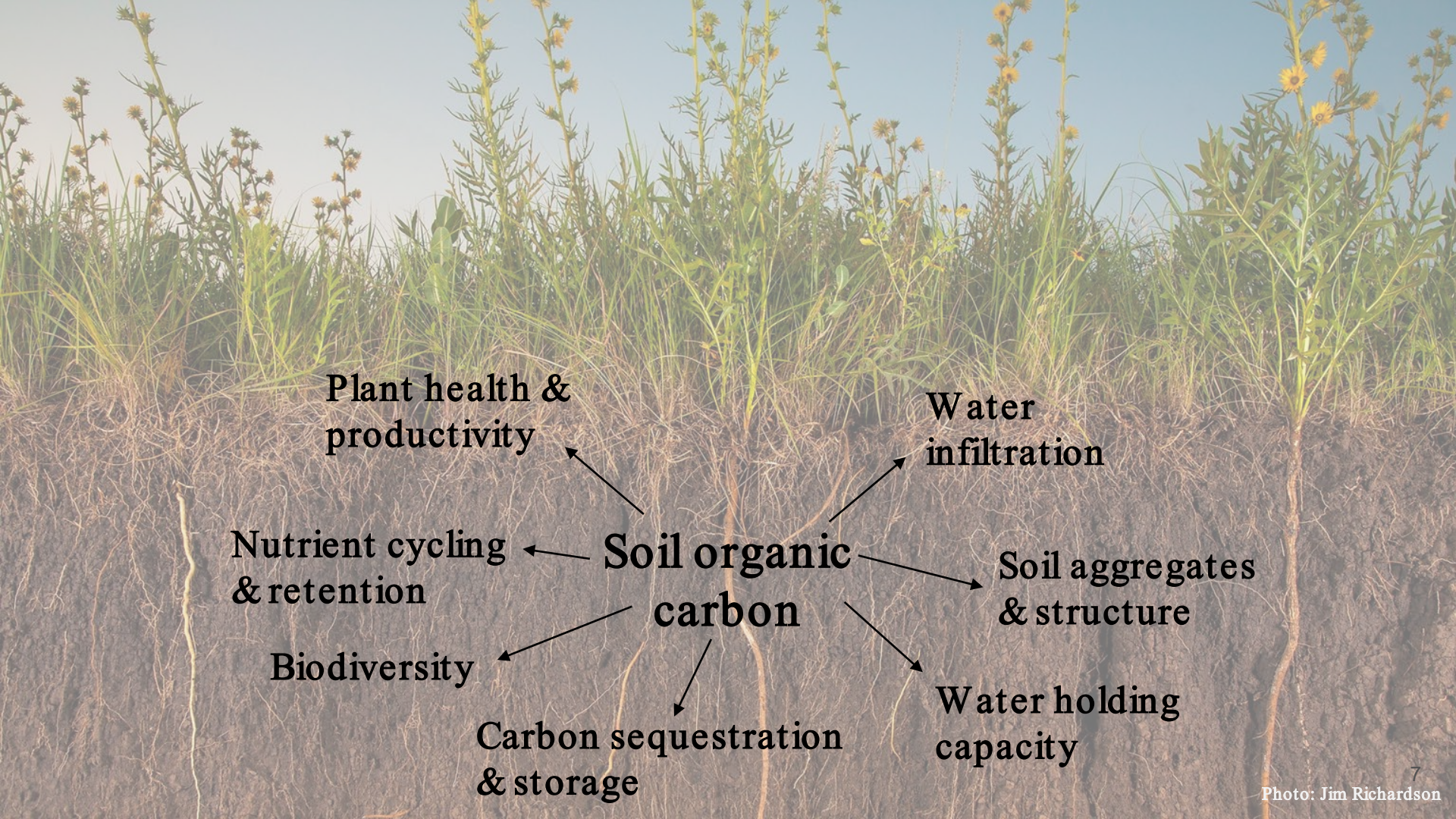
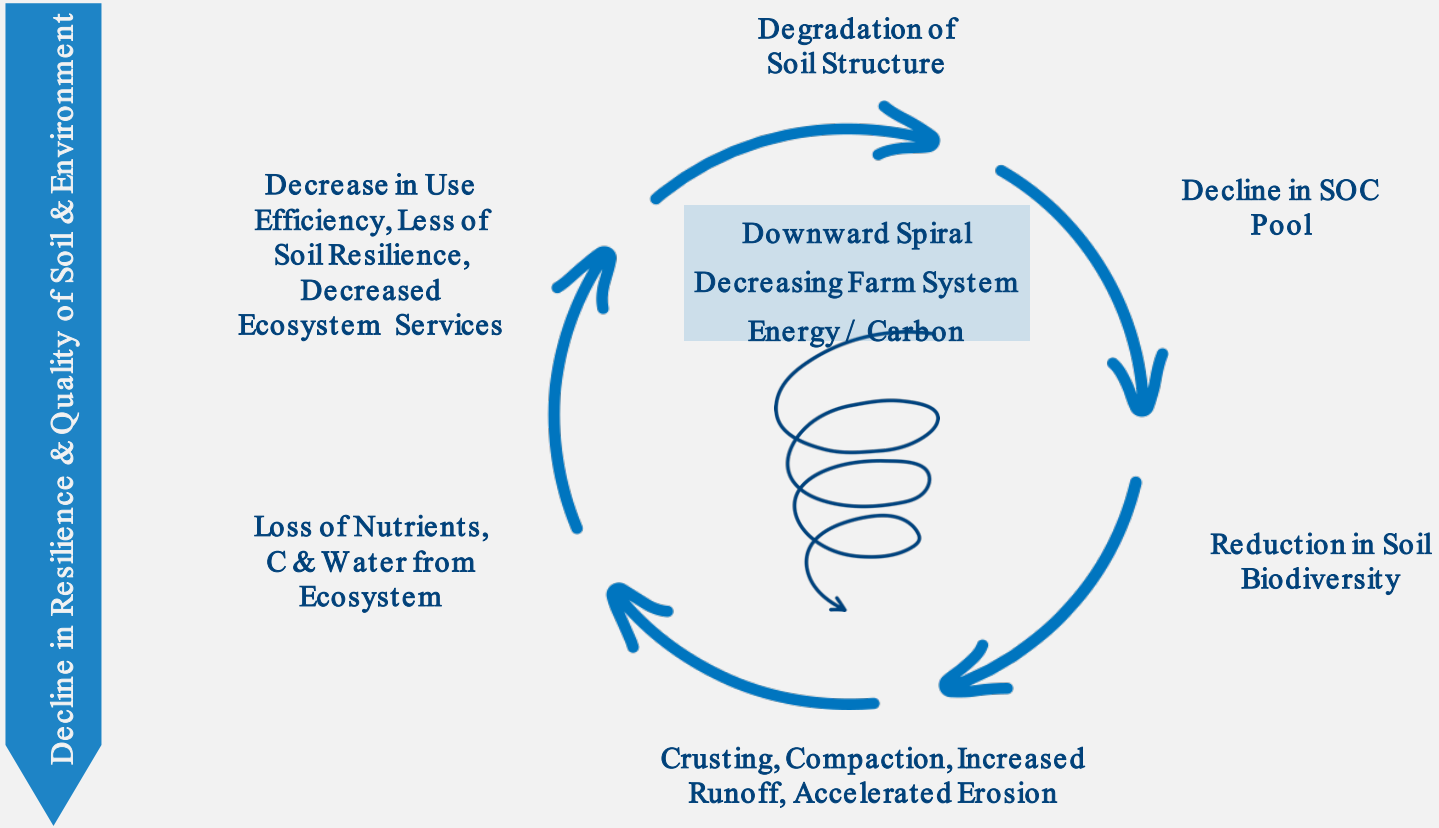


Photo: Jim Richardson

Extractive Farming

Residue Removal, Excessive Tillage, Negative SOC Budget, Negative Nutrient and Energy Budgets



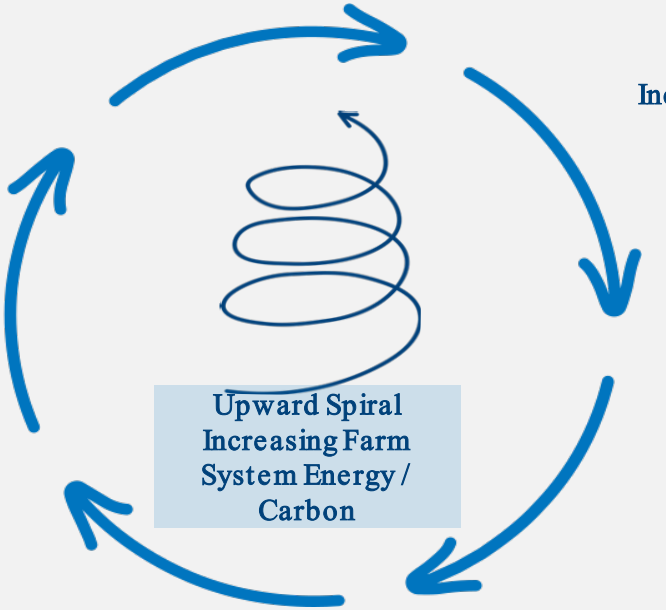
Decline in soil and environmental quality; increased risk of resource insecurity and political instability

Climate stresses contributing to harmful positive feedbacks contributing to climate stresses

Carbon Farming

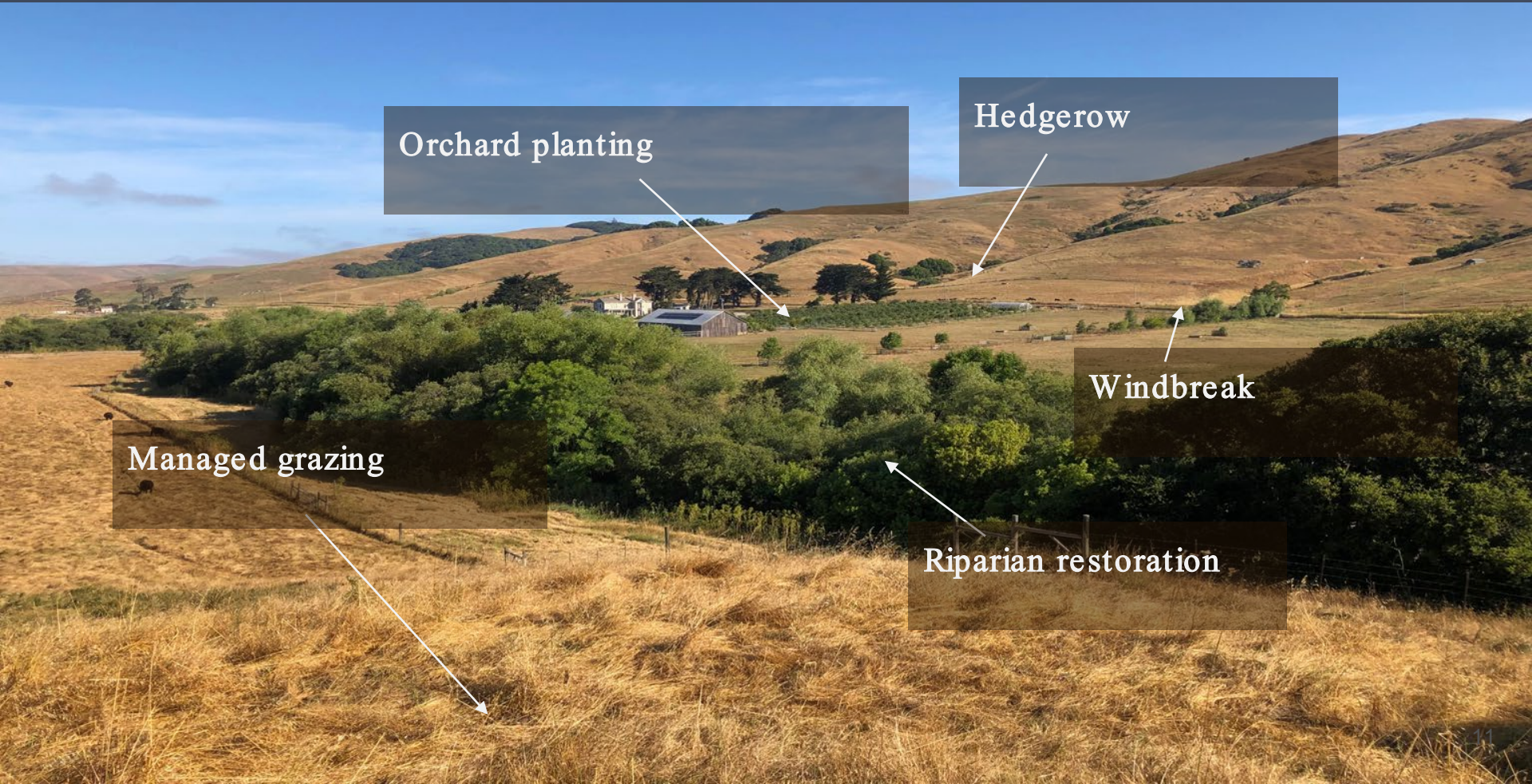
Residue Retention, Cover Cropping, Nutrient Cycling, Minimum Tillage, Agroforestry, Livestock Integration

Increased Soil & Environment Quality

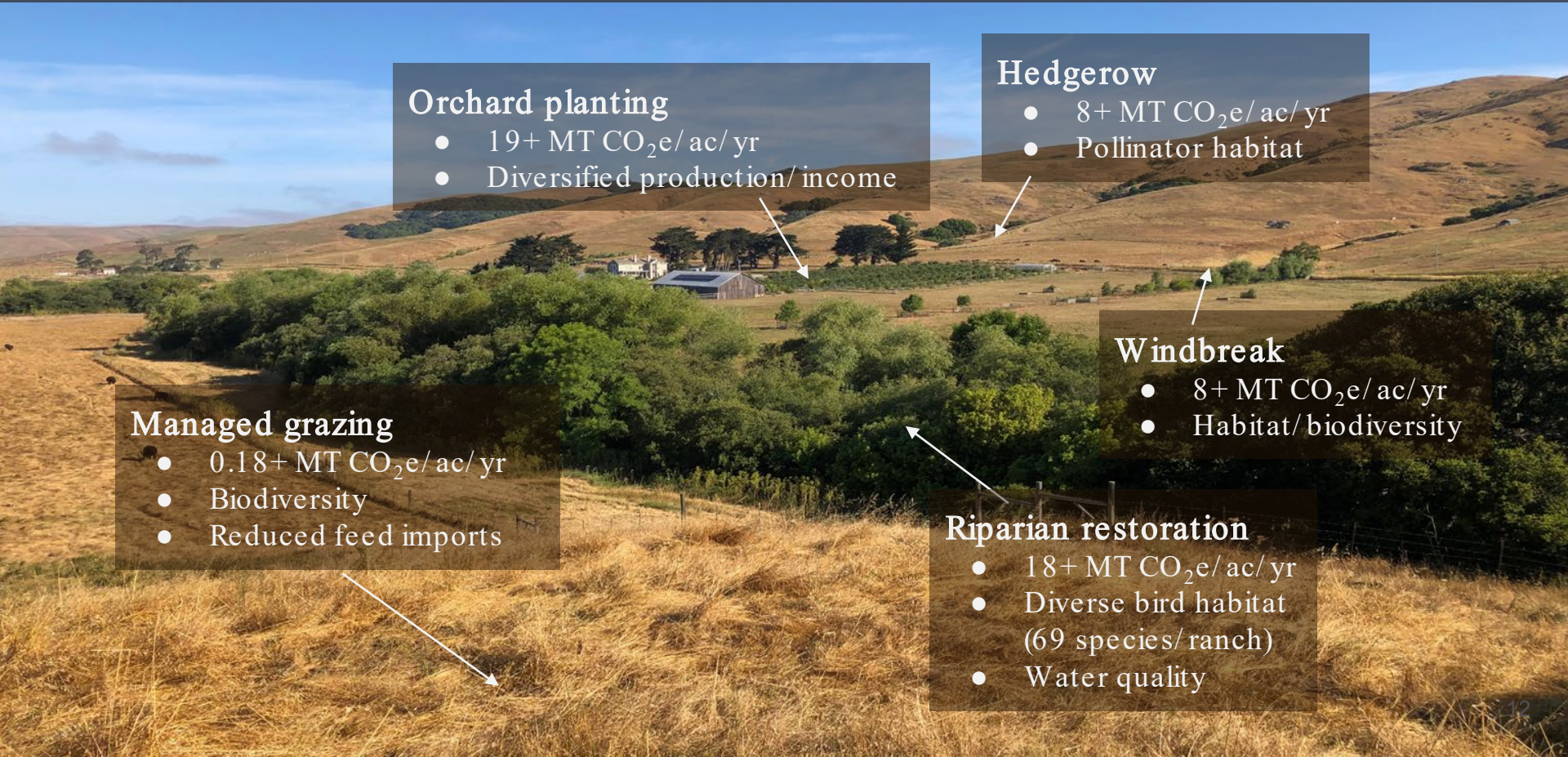


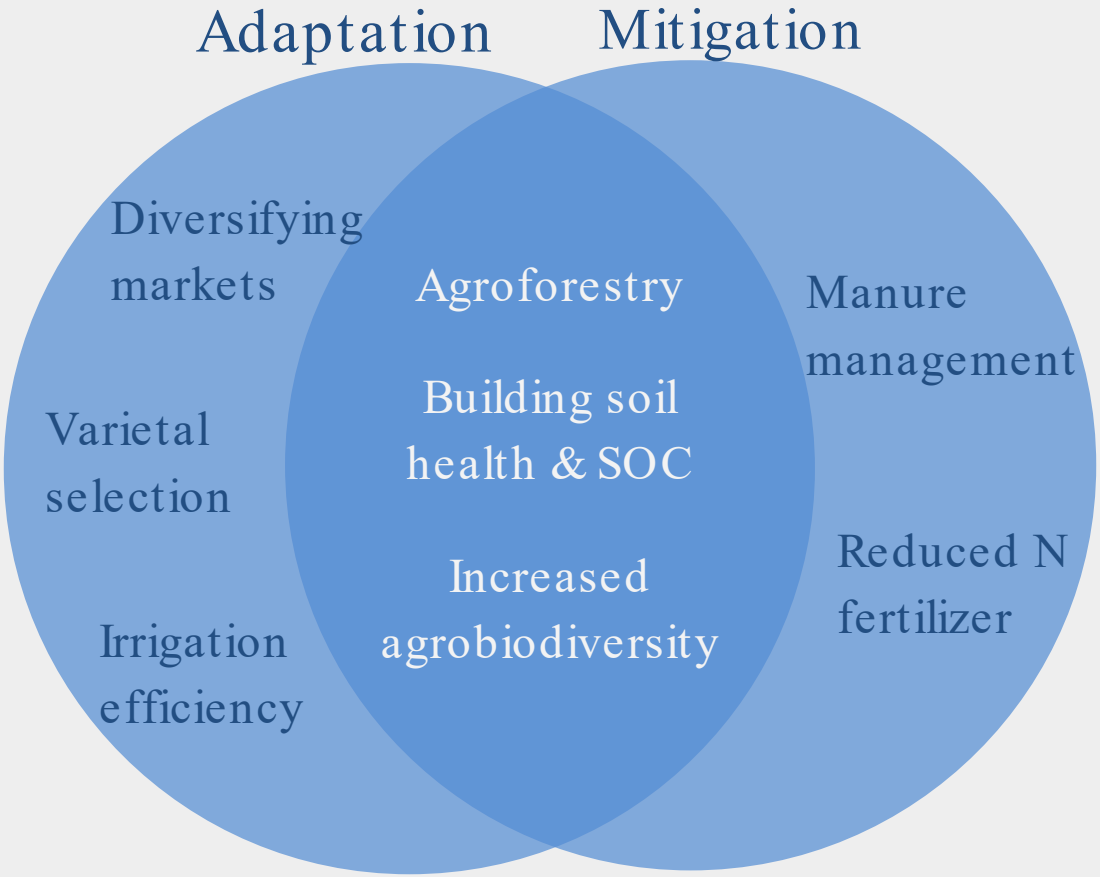
Restoration of soil & environmental quality, improvement in agroecosystem resilience & increase in social & political stability

Managing for increased agroecosystem carbon and farm system energy



Carbon farming is an investment in soil fertility, farm productivity, biodiversity, soil water holding capacity, groundwater recharge, water quality and farm resilience.





Managing for increased landscape carbon is the at the center of the synergy between adaptation and mitigation

Hydrological Impact of Soil Organic Carbon Loss

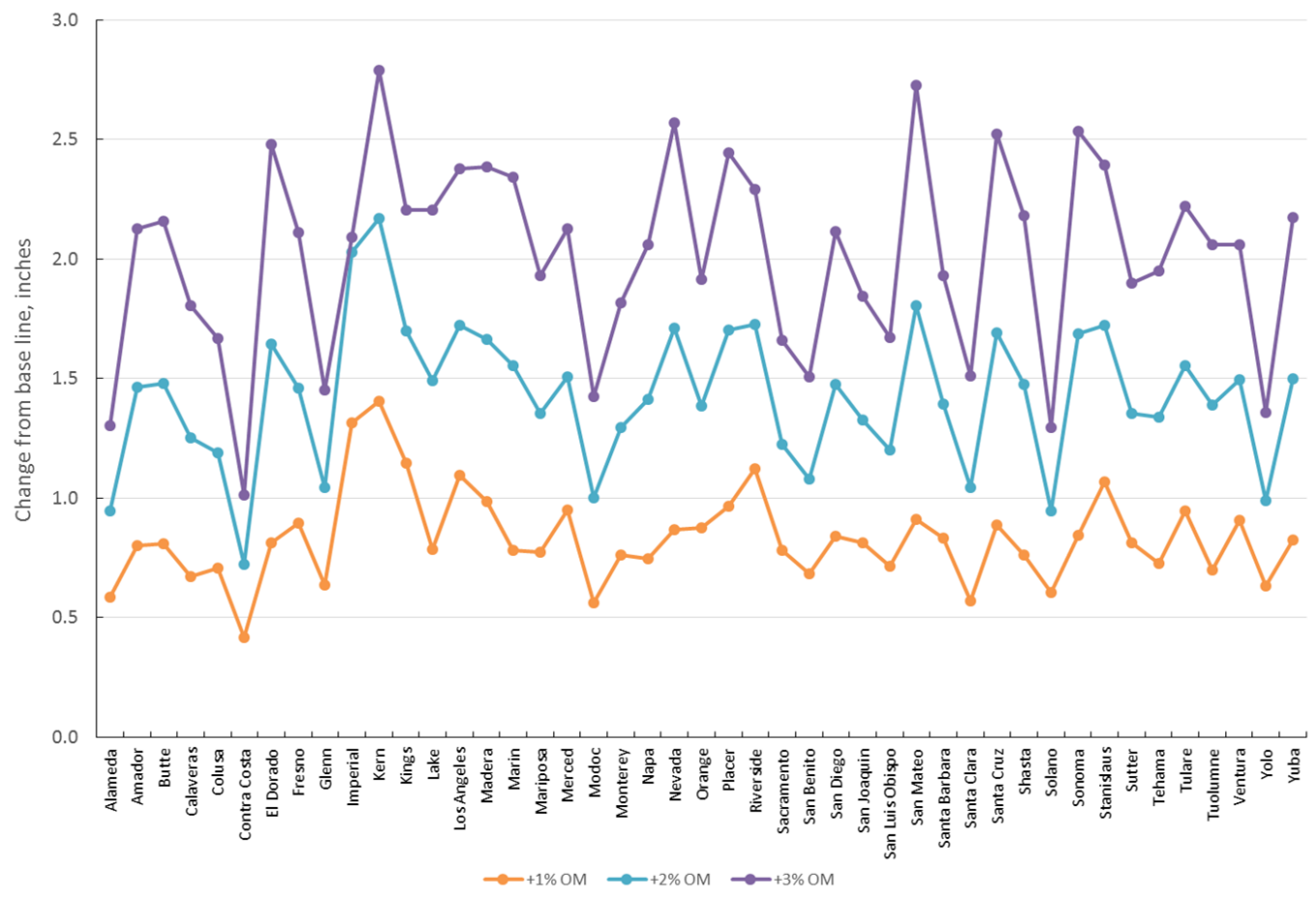
= Hydrological Impact of Drought (McDermid et al 2022)

Increasing SOC:

- Increases water infiltration (Basche and DeLonge 2019; Blanco-Canqui et al. 2015)
- Increases soil water holding capacity (Bagnall et al. 2022)
- Ameliorates drought and flood impacts on crops (Arenas-Calle et al. 2021; Iizumi and Wagai 2019; Webb et al. 2017; Williams et al. 2016)

Increased soil water holding capacity and ground water recharge through carbon farming are related to increases in SOC, increased root and symbiotic fungal growth, increased soil faunal activity associated with a denser rooting system, and increased soil aggregation that, collectively, decrease soil bulk density, increase soil porosity and enhance water infiltration.

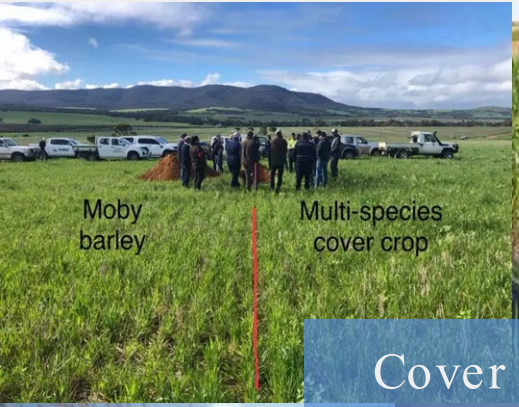
Increases in soil WHC with 1, 2, and 3% increase in SOM:
model results for 45 California counties



Flint et al. 2018. California's Fourth Climate Assessment.

California 1935 or 2035?

Scaling carbon farming



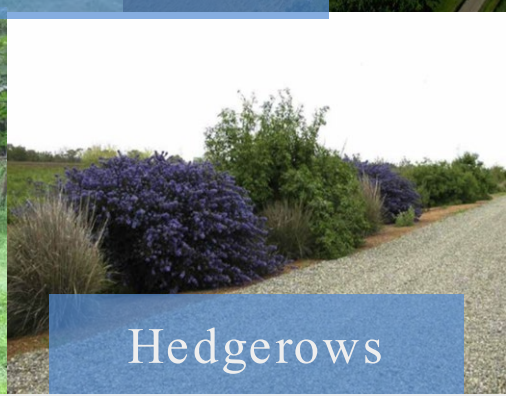
Cover Crops

Windbreaks

Reduced-till/ No-

Organic Matter Amendments

Silvopasture



Hedgerows

and many more

Thank you

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