Cultivating Soil Health and Water Quality with Innovation and Collaboration

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A three-year Great Plains-based project led by Sand County Foundation

Soil management is of critical importance in the Great Plains where there is growing concern of the impact that extreme precipitation events coupled with the loss of grasslands may have on water quality and quantity.

Sand County Foundation launched a three-year (2026-2028) partnership with 30-farmers and ranchers across eastern Nebraska and Kansas to understand how soil health management can support crop resilience and water quality within the Lower Missouri River Basin. Within this rainfed agricultural region, soils have become drier, and summer droughts are more prevalent. At the same time, precipitation falling during heavy fall and spring rainstorms has also increased.

This on-farm demonstration includes annual soil sampling and integrates soil moisture and temperature sensors to provide farmers and ranchers with real-time, first-hand data on how their land management impacts soil water storage. This approach allows immediate access so that the farmer collaborators are not left waiting until project completion for feedback. By pairing the farmers and ranchers with a neighbor who applies an alternative management approach to their land, this project strives to build collaborative networks to share data and findings, with a goal of improving land stewardship and empowering landowners.

Evaluation Approach

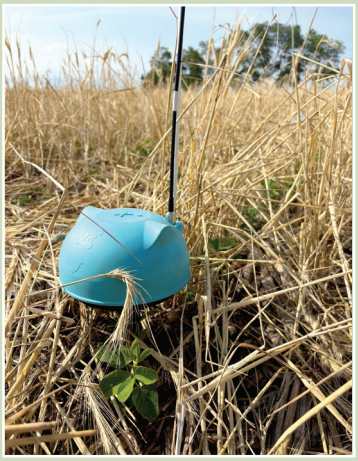
Fifteen paired demonstration sites (30 fields) were selected across southeast Nebraska and northeast Kansas. Half of the sites have used soil health management (i.e., minimal soil disturbance, cover crops, plant diversity, rotational grazing) for at least five years, while their paired fields have historically used conventional management (i.e., increased soil disturbance, minimal or no cover crops, no rotational grazing). Each pair comprises two neighboring fields on shared soil types and landscape position. To verify soil properties between the field pairs, SCF contracted EarthOptics to apply soil mapping technology to confirm electrical conductivity (EC) for each field, since EC is closely related to key physical and chemical soil properties.

SCF installed two CropX sensors in the dominant soil type observed across the paired fields. The sensors record soil moisture and temperature every 30 minutes at depths of 4, 12, and 22 inches during the growing season.

Each fall, three 0–6-inch composite soil samples will be collected from three locations around the sensors. Samples will be analyzed for soil health properties, including the parameters listed in the table.

Soil health property	Why we measure it
Biological	
Active carbon (permanganate oxidizable carbon-POXC)	Reflects the amount of readily available carbon feeding soil microbes; a sensitive early indicator of soil health change.
Phospholipid fatty acids (PLFA)	Quantifies the microbial biomass and community composition living in the soil.
Chemical	
Total organic carbon (TOC)	Measures the total carbon stored in soil organic matter; higher levels are an indicator of better soil fertility and structure.
pH	Measures soil acidity or alkalinity; directly affects nutrient availability and microbial activity.
Cation exchange capacity (CEC)	Reflects the soil's ability to retain and supply essential nutrients to plants; a higher CEC is an indicator of fertile soil.
Plant-available phosphorus (P)	Measures phosphorus accessible to plants; critical for photosynthesis, root development, flowering, and yield.
Physical	
Water-stable aggregates (WSA)	Indicates the ability for soil particles to hold together when wet; better aggregation results in less erosion and improved water infiltration.

SCF will evaluate the data collected across the 30 sites to provide each of the collaborating farmers and ranchers with an understanding of how their land management influences water infiltration and holding capacity, nutrient leaching, soil aggregate stability, and other soil health properties that support system resilience.



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PARTNERS & SPONSORS

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Sand County Foundation inspires and empowers farmers, ranchers, and forestland owners to ethically care for the land to sustain water resources, build healthy soil, enhance wildlife habitat, and support outdoor recreation.

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