

Ag Data Standards and Interoperability Protocols

GLCDI | CONCEPT BRIEF 01



STATEMENT OF PURPOSE

As the Grazing Lands Carbon Data Initiative (GLCDI) moves out of Discovery Phase, the research activities that comprise the implementation phase should set agricultural data standards and interoperability protocols for beef production systems that enable the practical integration of data needed for decision-making, research, and impact modeling across diverse programs, platforms, applications, or models. This guidance should prioritize data needed for Soil Organic Carbon (SOC) Modeling including data related to management and production, herds, grazing, feed use, manure management, and soils characteristics.



CONTEXT

The Grazing Lands Carbon Data Initiative brought together participants to reflect on and explore the state of soil carbon data collection in beef production systems. The key objective of this event was to identify the gaps in data required to understand the relationship between grazing cattle and soil carbon, and to begin framing the costs, both financial and operational, of closing those gaps.

The lack of robust, comprehensive datasets on soil carbon means that current models are incomplete, particularly when it comes to representing the variability across different U.S. regions. Both management data and SOC data are necessary in order to accurately identify and fill critical data gaps. There are competing standards for soils data that need to be resolved for this to occur. This includes variation in sampling location stratification, sampling depth, aggregated and disaggregated sampling at the field level, and methods for laboratory analysis. There is also a lack of management data being collected in livestock operations which needs to be addressed

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alongside the effort to create a management data standard for livestock operations.

During discussion, researchers and conservation organizations voiced strong support for public accounting systems, arguing that making more data publicly available would accelerate progress in soil carbon modeling. However, agricultural technology providers were often reluctant to share proprietary data, as it formed the basis of their intellectual property. Reconciling this tension remains a critical challenge moving forward.

Particularly among the research working group - there was a strong sentiment that private agricultural technology providers have some of the richest data, but that researchers have no

idea what data they have, let alone the quality of the data and whether that data has been collected with consent that would warrant its continued use.

Interoperability protocols will be crucial and build on the data standardization efforts to make it easier for comparability across software and programs and importantly enable private data repositories to be more accessible for public research and accounting. An added producer benefit of interoperability is the avoidance of vendor lock-in, where the producer becomes dependent on a specific software and it is difficult or impossible to change platforms, by providing the opportunity to move between different technology platforms and programs based on their need.



WHY INTEROPERABILITY MATTERS

Interoperability protocols enable data collected with consent to move between programs and platforms, making it easier to compare data, support research and accounting, and avoid vendor lock in.

REQUIREMENTS

During Working Group sessions and Steering Committee meetings, a number of requirements for data standards and interoperability protocols were identified.

- › Map current standards for data, metadata, and infrastructure related to soil sampling and laboratory analysis
- › Identify initial steps for integration of current standards as a pathway to future interoperability
- › Collaboratively develop guidance for standards and protocols to support the breakdown of existing data silos

Ag Data Governance, Incentives, and Education

GLCDI | CONCEPT BRIEF 02



STATEMENT OF PURPOSE

As the Grazing Lands Carbon Data Initiative (GLCDI) moves out of Discovery Phase and into Reference Implementation Phase, this research goal is to develop the necessary business, operational, legal, technical, and social (BOLTS) infrastructure for agricultural data governance, alignment of stakeholder incentives, and stakeholder education to enable trusted data sharing that supports a scalable system for producer decision-making and beef supply chain stakeholders.

CONTEXT

The Grazing Lands Carbon Data Initiative brought together participants to reflect on and explore the state of soil carbon data collection in beef production systems. The key objective of this event was to identify the gaps in data required to understand the relationship between grazing cattle and soil carbon, and to begin framing the costs, both financial and operational, of closing those gaps.

One of the most important outcomes of this engagement was the recognition of the tensions that exist between different stakeholder priorities. The producers we spoke with, for example, consistently emphasized their need for data sovereignty and transparency, particularly regarding how their data is used and shared. On the other hand, corporate stakeholders were more focused on the need for interoperable systems that allow for efficient, scalable use of data across platforms. These differing priorities were a key theme throughout the Collabathon and subsequent discussions, and the initiative acknowledged the challenge of finding common ground in these areas. These differences in perspective, needs, and

incentives led participants to conclude that there are a number of governance-related issues that will need focused attention and ongoing effort to address. There was also a notable self-selection process in producer participation in the GLCDI. Those producers who are already interested and engaging with data collection were the ones to participate. However, they provided insights about producers as a whole.

Participants in the producer working group noted that, in the United States, there are three primary categories of producers based on their data collection practices. First, a very small minority of producers are already collecting data related to soil health and ecosystem changes. These producers simply believe in the value of data collection.

Second, the largest group consists of producers who are not yet collecting data relevant to this workstream but may be open to it in the future. These producers need instruction, trusted partnership, and capacity building to build trust to begin data collection. Finally, there are the producers who are unlikely ever to collect or share their data - they will never trust others with their data. According to insights from a producers'

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working group, the number of producers who have organized data is very small.

Targeting the second, largest group is essential, but initiating data collection with these producers requires significant trust-building. It was consistently emphasized that without a unified strategy focused on education and capability enhancement, efforts to collect data would likely fall flat. “Education, education, education” was a common sentiment. This education was described in the following categories: understanding the greater ‘why’ behind data collection, understanding how data collection can support farm management, understanding the risks and benefits of participating in data



WHY PRODUCER TRUST MATTERS

Building a stronger data ecosystem requires producer trust. Clear agreements, meaningful incentives, and transparency can encourage broader participation in data collection and sharing.

collection, understanding data collection roles and investment requirements, and understanding the legal agreements themselves.

These realities helped frame why corporations are able to access limited primary data from producers in their supply chains. The recognition that a supply-chain partnership approach to developing the necessary governance, incentives, and education will be key to filling the gaps in data that prevent accurate accounting.

REQUIREMENTS

During Working Group sessions and Steering Committee meetings, a number of requirements for data governance, stakeholder incentives, and producer education were identified..

- › Implement standardized short and simple, modular contracts and data usage agreements that protect data owners interests
- › Develop funding strategy to support alignment of stakeholders interests towards incentivized data collection and sharing
- › Identify and test innovations to lower the cost of field-data acquisition and analysis
- › Develop strategy and incentives to normalize and scale the practice of farm and grazing management planning both analog and digital
- › Co-design and test the peer-to-peer data sharing networks that will support producers learning and provide clear benefits to producers

¹ The BOLTS framework—encompassing Business, Operational, Legal, Technical, and Social dimensions—was first introduced by Dazza Greenwood in the context of computational law and trust architectures. While the exact date of its initial publication is not specified in the available sources, Greenwood has extensively discussed and applied the BOLTS framework through various platforms, including his consultancy CIVICS.com and research initiatives at MIT, such as law.MIT.edu. connection.mit.edu. The BOLTS framework serves as a comprehensive model for designing and analyzing systems that require integrated considerations across business strategies, operational workflows, legal compliance, technical infrastructure, and social dynamics.

Soil Carbon Data Aggregation

GLCDI | CONCEPT BRIEF 03



STATEMENT OF PURPOSE

As the Grazing Lands Carbon Data Initiative (GLCDI) moves out of Discovery Phase and into Reference Implementation Phase, this research should support the development of the minimum requirements, ontologies, and implementation process for a National Grazing Lands Soil Carbon Calibration Dataset.

A national calibration dataset is the minimum data required to train nation-wide models for Soil Organic Carbon (SOC) and to update those models on a regular basis. Key questions to be addressed are the frequency of model updates, the data structure necessary to accommodate various models as outlined in the context section (RN-00), and the costs associated with implementing this at scale.



CONTEXT

The Grazing Lands Carbon Data Initiative brought together participants to reflect on and explore the state of soil carbon data collection in beef production systems. The key objective of this event was to identify the gaps in data required to understand the relationship between grazing cattle and soil carbon, and to begin framing the costs, both financial and operational, of closing those gaps.

There are two distinct data gaps: one is the lack of data needed by researchers to train, test, and improve existing soil organic carbon models. The second is dependent on the first - once models are fully tested and accepted for given regions - those models will require data to run and generate outputs. Once these models are validated and ready for broader application, the volume, content, and format of input data required for accurate outputs will become more clear. Currently, researchers struggle with unusable data recorded on paper, stored in proprietary datasets,

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or not collected at all. If we had access to better data, researchers could more accurately quantify these gaps and propose solutions.

It is clear that the development of a national calibration dataset that can be utilized by researchers in training and improving SOC models is a critical next step in the US. To do so will require a data standard that can be deployed nationally or used to format existing datasets including both soil data and management data that are necessary to model the dynamics



WHY A NATIONAL DATASET MATTERS

A national calibration dataset would provide researchers with consistent, representative soil and management data needed to train, test, and improve soil organic carbon models across diverse U.S. grazing landscapes.

between animal management and soil response. It will also require a strategy for representative sampling across the diverse landscapes that are grazed in the US.

REQUIREMENTS

During Working Group sessions and Steering Committee meetings, a number of requirements for a SOC national calibration dataset were identified.

- › Co-design stakeholder data strategies for:
 - › Federal lands including US Forest Service and Bureau of Land Management
 - › Large ranch owners
 - › Conservation organization managed or supported lands
 - › Landscape coalitions
 - › Tribal Lands
 - › Smallholder or BIPOC owned or managed lands
- › Co-develop appropriate minimum data requirements and ontologies
- › Test and contribute to case studies for successful data collection efforts within the minimum data requirements and ontologies