

2025 ANNUAL MEETING IMPACT REPORT

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National Agricultural Producers Data Cooperative

Designing a Strategic Framework for Increasing Production and Driving Innovation



NAPDC ENGAGEMENT

Poster Presentation:

Tree of Tables (ToTs): Model for Agricultural Data Interoperability

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Tree of Tables (ToTs): A Pragmatic Model for Achieving Long-Term Interoperability in Global Agricultural Data

PRESENTER:
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What is a **Maximally Interoperable Model**?
The key missing element in interoperability definitions is the recognition that **it is a sentiment held by the people involved**.

$$M = \text{ARGC} \rightarrow \sum_{i=1}^n \text{ARGC}_i(A_i, A_j) \rightarrow \left(\frac{\sum_{i=1}^n \text{ARGC}_i(A_i, A_j)}{n} \right)$$

A **MIM** is a model that **maximizes ΔT** .

Agriculture's Key Distinction: Time

$C_1^{t=0}$	$C_2^{t=0}$	$C_3^{t=0}$	...	$C_n^{t=0}$	\rightarrow	$[C_1^{t=0}]^{t=0}$
$C_1^{t=1}$	$C_2^{t=1}$	$C_3^{t=1}$	...	$C_n^{t=1}$	\rightarrow	$[C_1^{t=1}]^{t=1}$
$C_1^{t=2}$	$C_2^{t=2}$	$C_3^{t=2}$	...	$C_n^{t=2}$	\rightarrow	$[C_1^{t=2}]^{t=2}$
$C_1^{t=T}$	$C_2^{t=T}$	$C_3^{t=T}$	...	$C_n^{t=T}$	\rightarrow	$[C_1^{t=T}]^{t=T}$

This highlights a frustratingly critical requirement of a MIM: **it is heavily biased against the "new."** Anything "new" which solves a problem of today cannot easily overcome the proven history of staying power from the "reliable."

Cloud and API Friendly
Soil-lab data using Modus standard in ADC:

<https://github.com/qats-center/modus>

Tree of Tables (ToTs)

is a practical, future-proof way to make **ag data** interoperable—today and **decades from now**.

It can be made to work on nearly every common platform, is accessible to both laymen and machines, and will likely be accessible for decades to come.

ToTs is one of the best **Maximally Interoperable Models (MIMs)** for **data in agriculture**.

Maximally Interoperable Models (MIMs):
A Heuristic Approach for Evaluating Interoperability
<https://doi.org/10.3390/ag11010001>

ToTs Basics

CSV Serialization: everyone can read these. Since the 1990's.

Standardized "Logical Geography" => folder structures: everyone can store/transfer/zip folders. Inherent $O(\log n)$ indexing.

Ambient Context: location in tree informs types, units, schemas.

Widespread common tooling: Excel, Tableau, PowerBI, AI data analysis tools.

Language independence: nearly all programming languages can directly utilize ToTs.

AI-Ready: ToTs is an ideal format for data ingestion and inference for LLMs and other AI tools since it carries inherent human-interpretable structure.

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△ Yuguang Zhang, Aaronault

In recent work on Maximally Interoperable Models, interoperability is a human-centered property: data are truly interoperable when the time, effort, and specialized knowledge required to use them are minimized for the widest range of current and future users and systems. In agriculture, where decisions span seasons to decades, models also need “staying power“.

To meet this need, the Open Ag Tech & Systems (OATS) Center developed Tree of Tables (ToTs): a simple but rigorous way to publish data as spreadsheets/CSVs (the leaves) organized in a clear folder hierarchy (the tree). The structure carries “traveling context” with files and “ambient context” in the folder structures, making data both human-legible and machine-ready.

Over the past year, the team has created an open-source Modus→ToTs conversion pipeline with Shapefile and GeoJSON support and a merge utility that links lab results to sampling locations. We are building a browser-based soil-health prototype (map + time-slider) that lets producers explore trends in soil properties over time while keeping their data in their own platforms.

Exhibitor Booth:

NAPDC in collaboration with GOAT

Gathering for Open Ag Technology is a collective that aims to coordinate existing development in the ag data space, invite new development, align technology and actual users and create a collaborative roadmap.

Different organizations such as NAPDC, Point Blue Conservation Science, The Soil Inventory Project, Terraso, University of British Columbia, etc have come together to address key challenges in the open-source development area such as data sharing, inter-operability, closed data ecosystems, etc. The shared booth showcased informational materials, handouts and interactive displays explaining the open ag tech landscape, current gaps and our collective vision. We also invited conference attendees to share challenges, solutions and connected with partners actively building the future of open ag technology, in the spirit of networking and dialogue.





NATIONAL AGRICULTURAL PRODUCERS DATA COOPERATIVE





Our Objectives

- ✓ Develop a blueprint for a National Agricultural Producers Data framework
- ✓ Engage and support diverse participation
- ✓ Communicate and disseminate findings

To create innovative, data-driven agricultural production systems, producers will need access to their own data, simulations, forecasts, and modeling to learn how they can transform their operations towards enhancing sustainability. Our goal is to gather essential information needed to inform a cross-domain and cross-community data framework that can support a "grower data lake" across diverse national and regional agricultural systems.



AG DATA
REPOSITORY



DATA FRAMEWORK



SATELLITE
IMAGERY

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