

POLICY BRIEF 2:

Safeguarding Traditions, Enhancing Agriculture: Indigenous Data Sovereignty as a Tool in the Age of AI Centered Agriculture



“Make sure Tribal Nations have access to their data, control of their data, and don't pay for their knowledge!”

TO :

All who engage with Tribal Agriculture – practitioners, agriculture data and technology developers, and Indigenous Knowledge Keepers – focused on protecting cultural practices and data for future generations in relation to Indigenous agriculture.

FROM:

A diverse group of Indigenous agriculture practitioners, data scientists, and Indigenous Data Sovereignty (IDSov) scholars that discussed agriculture technology and Indigenous data priorities in the US.

Designed and facilitated by an Indigenous-led steering committee, representing 8 different Tribal Nations throughout the United States, the Collaboratory for Indigenous Data Governance two-day, virtual “Past, Present and Future Indigenous Data Sovereignty Needs in Agriculture Workshop” on November 16-17, 2022 was supported by funding from the National Science Foundation (NSF) and United States Department of Agriculture (USDA). This is the second of two policy briefs related to the gathering. For further information, please see **Policy Brief 1: Intersection of Indigenous Data Sovereignty and Tribal Agriculture Data Needs.**

The interactions among Indigenous Data Sovereignty (IDSov), agriculture, and developing technologies, including remote sensing, Artificial Intelligence (AI), and Machine Learning (ML) remain unexplored. While technological innovation and data optimization are increasingly being centered in the farming industry and federal grant calls (such as USDA NIFA, USDA AFRI, NSF USDA FRR), many attendees, referred to as Workshop Experts in this brief, wanted to explore how IDSov and Indigenous food sovereignty align. Considerations of IDSov and Indigenous data governance (IDGov) within emerging agriculture technologies are of concern to both traditional and nontraditional farmers and ranchers, along with Tribal Nations, communities, and their leaders. As agriculture expands to be more technocentric, and funding agencies incentivize research using AI, ML, and other emerging technologies, IDGov remains an absent but needed part of the conversation.

PUSHING THE BOUNDARIES FOR INDIGENOUS AGRICULTURE SUCCESS

The use of technology and large-scale data collection in agriculture raises questions about how “success” is defined. Mainstream agriculture metrics of success are often characterized as SMART (specific, measurable, achievable, realistic, and time-bound) and typically include measures of farm size, type, profitability, producer characteristic, and other variables (USA Census, 2022). Increasingly, there are efforts to move away from SMART metrics towards FAST metrics (frequency discussed, ambitious, specific and transparent) (Sull & Sull, 2018). FAST metrics may better align with priorities communicated by Indigenous farmers and ranchers. Workshop Experts identified the desire to redefine how data is collected to better reflect Indigenous priorities, needs, and practices in order to reclaim and revitalize traditional data relations to agriculture knowledge. Workshop Experts identified four different ways they can push the boundaries of Indigenous agricultural success:

1. Culturally Defined Metrics of Success

Success should be defined by Indigenous Peoples. Metrics of success must center Indigenous values and practices of ecological health while also acknowledging the rights of nature. This means the recognition that ecosystems have inherent rights and legally should have the same protections as people and corporations to exist, thrive, and regenerate. These culturally defined metrics of success will focus on ecosystem and community sustainability rather than profitability, thereby challenging and moving beyond western colonial agriculture definitions. An example of this could be an exemption from USDA policy so Tribes decide what success looks like for each community.

2. Centering Indigenous Values

Indicators of success must center Indigenous values, including passing on of songs, stories, and ceremonies to youth; preparation and harvesting; community health; land health; and reintroducing cultural practices of the land. Centering Indigenous values encompasses the recognition and acknowledgement of a Tribe's more than human relatives along with their wellbeing and continuance within practicing agriculture. These actions are done to both produce food for the community and to protect the land. Centering Indigenous values centers the people and the land.

3. Harmonizing Culturally Defined Definitions of Success with Centering indigenous Values

Agriculture success harmonizes culturally defined metrics of success with Indigenous values, thereby shifting the emphasis to non-commercial impacts. Culturally defined metrics of success include: (1) holistic community needs; (2) affirming practices that support health, environment, interpersonal connections, and cultural connections; and (3) involvement in agriculture practices. Indigenous agriculture practices (1) regenerate soil, (2) create habitat, (3) clean and purify water, and (4) create sanctuary, wellness, and health for human and more than human relations. The harmonization of culturally defined metrics of success with centering Indigenous values will look at Indigenous data (such as the number of seeds and varieties) that are ethically returned while also looking at the economic and social well-being of farmers, ranchers, and food systems workers so their work is valued and respected.

4. “Indigenous Peoples Working Indigenously”

“Indigenous Peoples working Indigenously,” is a vital indicator of agriculture success because it means communities are defining boundaries based on their own systems of control, management, stewardship, and sustainable outcomes. This also includes Native people working Native lands; increasing Native access to land; revitalization of Indigenous agriculture practices; and awareness of how much traditional foods are being grown and gathered. There is also an emphasis on cultural practices and ceremony being incorporated into community land use.

PRACTICAL USES OF ARTIFICIAL INTELLIGENCE (AI) AND MACHINE LEARNING (ML) IN INDIGENOUS AGRICULTURE

Workshop Experts initially expressed unease with discussion of AI and ML. Subsequently, the dialogue focused on applications of these technologies and the scope of the data collected. Advancements in AI and ML have helped improve mainstream agriculture by providing data-centric recommendations across all stages of farming (Meshram et al, 2021). The application of AI and ML in agriculture enables more efficient and precise farming production through improved monitoring of growing conditions and pest management. They are also embedded in agricultural tools and platforms of tractors, automated weather stations, and satellite readings. Three practical uses of AI and ML for Indigenous farmers were identified, including:

1. Remote Sensing

A widely recognized and practical applied use of AI and ML among Workshop Experts is remote sensing. Uses include predictive soil mapping, smart sensor networks to conserve limited resources, and landscape assessments. A specific example includes the use of drones for quantification of water collection potential, high-resolution aerial imagery, and overall land management tools.

2. Monitoring and Modeling

Workshop Experts Identified possible uses of AI and ML in agriculture including the monitoring of ecosystem health, change, adaptation, and resilience. AI and ML can also be used to increase efficiency in resource use and yield, mitigate potential risk, design built landscapes, and future use planning. However, before any practical uses, Workshop Experts identified the need to establish appropriate AI and ML protocols for Indigenous applications.

TERMINOLOGY

Indigenous Agriculture and related practices: a set of heavily localized practices embedded in broader understandings of ecosystem, climate, and community. Varying widely by Tribal Nation, location, and cultural practices, Indigenous agriculture is often less extractive than settler and industrial practices, emphasizing community ownership and long-term ecosystem health (Wluka, 2023).

Indigenous Agriculture Practitioners: a variety of actors including seed keepers, commercial producers, ranchers, agriculture enumerators, those working in Indigenous food sovereignty, and those working in data optimization of agriculture production to improve the efficiency and safety of agricultural establishments and products (Jennings et al., 2025; Bureau of Labor Statistics, 2025)

Indigenous Data Sovereignty (IDSov): the rights of Indigenous Peoples to govern the collection, ownership, and application of their own data. IDSov derives from Indigenous Peoples’ inherent right to govern their peoples, lands, and resources.(Carroll et al, 2021)

Indigenous Data Governance (IDGov): policies and practices that support Indigenous Peoples in applying IDSov to articulate to the appropriate methods by which to collect, store, analyze, and use data. (Carroll et al, 2019)

Indigenous Food Sovereignty (IFS): the right of Indigenous Peoples to define and control their own food systems, based on land stewardship, self-determination, Indigenous values and practices (Maudrie et al., 2021; Rowe et al., 2024; Whyte, 2016).

Indigenous Food Systems: the complex and dynamic interactions between social, economic, and environmental actors involved in Indigenous food production, distribution, consumption, cultivation, harvest, and disposal (Kuhnlein & Chotinboriboon, 2022).

Indigenous Agriculture Data: knowledge and information generated by Indigenous Peoples’ relationship to land and their food systems through observations, storytelling, oral histories, community protocols, seasonal and ecological changes, and other culturally grounded knowledge, reflecting their values and care of the land, community, and all living beings (Jennings et al., 2025).

The CARE (Collective Benefit, Authority to Control, Responsibility, and Ethics)

Principles for Indigenous Data Governance: people- and purpose-oriented principles that reflect the crucial role of data in advancing innovation, governance, and self-determination among Indigenous Peoples. CARE directs data actors to engage with the communities that relate to the data for guidance on appropriate data stewardship, access, and use (Carroll et al, 2020; Indigenous Data Lab, 2025).

Workshop Experts: Subject matter experts selected by our steering committee who possess in depth lived expertise in the Indigenous agriculture field and contribute to knowledge and policy related to Indigenous agriculture.

More than human relations: refers to the interconnectness and interactions between humans and all other living and non-living entities, including plants, animals, Earth, and landscapes that centers from Indigenous worldview (Whyte, 2011).

Artificial Intelligence (AI): the imitation of human intelligence in machines that are designed to think like humans and replicate their behavior such as learning, reasoning, planning, and problem-solving (Sharma et al, 2021). AI study areas include search algorithms, knowledge graphs, natural language processing, expert systems, evolution algorithms, and machine learning (Nath et al, 2024).

Machine Learning (ML): a subset of artificial intelligence used as a tool to identify, understand and analyze patterns in data (Sharma et al, 2021).

Indigenous Data (digital or not): information generated by Indigenous Peoples that consist of past, present, and future Indigenous knowledge on (1) the environment, lands, skies, resources, and more than-humans relations; (2) Indigenous persons such as administrative, census, health, social, commercial, and corporate; and, (3) Indigenous Peoples as collectives, including traditional and cultural information, oral histories, ancestral and clan knowledge, cultural sites, and stories (Royal Society Te Aparangi, 2023; Carroll et al., 2020).

Remote Sensing: the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Special cameras collect remotely sensed images, which help researchers “sense” things about the Earth (NOAA, 2024).

3. Understanding Ecosystems

Workshop Experts discussed how AI and ML can be used to understand agriculture practices on multiple scales (from molecular to site, watershed to regional) with the ability to disaggregate from data sets for community or Tribal Nation purposes. The use of AI and ML depends on the scale of the agriculture system being assessed. For example, commercial and large scale agriculture initiatives use AI to harvest, weed, irrigate, and apply fertilizer and pesticides while smaller community farms typically do not use these technologies, though they contribute data through dashboard equipment and geospatial locations.

Use of Artificial Intelligence and Machine Learning can introduce concern and conflict

Workshop Experts highlighted how the use of AI and ML in agriculture has raised concerns and potential points of conflict. Some perceived these technologies as “removing humans out of the process,” thereby undermining vital human relationships and connection to the land. Other concerns were raised surrounding “ownership” of data regarding the rights to traditional seeds and foods from community lands, fields, and kitchens, as AI and ML has influenced this knowledge. There were also worries of negative impacts of data privacy breaches. In contrast, other Workshop Experts view AI and ML as useful tools in providing analysis to understand community usage dynamics, such as availability of foods with climate change shifts and food preferences of community members.

FUTURE AI & ML CONSIDERATIONS

Workshop Experts appreciated this space to learn from one another, but all agreed that deeper discussions were needed. Key points raised included:

- Educate farmers and ranchers on the uses of AI and ML to help increase understanding and address unease with new technologies. This provides the knowledge and tools to utilize and integrate AI and ML based on their own needs and priorities.
- Train farmers and ranchers on IDGov and protection policies for the use of their data.
- Establish an Indigenous agriculture

“Not more questions, but more time to further discuss, explore, and envision this topic”

network or agency (noting that organizations such as the Native American Agriculture Fund, Intertribal Agriculture Council, and the Tribal Agriculture Fellowship already exist) that specifically focuses on addressing data needs and data protections of Indigenous agriculture producers, both regionally and nationally.

- Develop a toolkit with examples and existing resources for Indigenous farmers, ranchers, and Tribal Nations interested in promoting IDSov, as well as culturally appropriate representations of data.
- Identify gaps and opportunities for continuous conversations with Indigenous communities related to Indigenous data governance and agriculture.
- Expand future workshops to include a more geographically diverse community of Indigenous agriculture experts to get a broader picture of IDSov needs and concerns around Indigenous agriculture. Involve a variety of farmers, ranchers, and food producers, including Elders/Knowledge Keepers as well as youth/future generations, Tribal leadership, and federal agencies in future workshops.

RECOMMENDATIONS

The following recommendations have been summarized based on the Workshop dialogue and supplement the recommendations from Policy Brief 1: Intersection of Indigenous Data Sovereignty and Tribal Agriculture Data Needs.

- Train the next generation of Indigenous farmers, ranchers, and scientists in data-related sciences. Begin early with data literacy and data education e.g., culturally relevant middle school, high school, and early college programming, especially within Tribal colleges and universities.
- Create Indigenous-based research institutions designed for the needs of Indigenous students, farmers, and ranchers working within Indigenous communities.
- Identify what Indigenous agriculture success looks like in relation to Tribal visions of sustainability. This includes pushing for an exemption from USDA policy so Tribes, not federal agencies, define what success looks like for their community. This topic needs more discussion in future workshops.
- Center Indigenous knowledge in the development of AI and ML in Indigenous communities. This includes prioritizing and abiding ethical and cultural considerations.
- Include Tribal and Indigenous languages as a component of AI and ML under Tribal control to aid in preserving and revitalizing languages associated with food practices

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