Science Societies

Nation’s largest research dairy set to bring new insights on irrigation, soils, and manure management

By Matt Ernst

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The Idaho Center for Agriculture, Food, and the Environment (CAFE). Photo courtesy of the University of Idaho.

The Idaho Center for Agriculture, Food, and the Environment (CAFE) is set to become the nation's largest research dairy, advancing studies in irrigation, soils, and nutrient management as Idaho's dairy industry rapidly expands. Ongoing research at the site—including evapotranspiration monitoring, soil variability analysis, and manure-management innovations—aims to improve water efficiency, crop productivity, and environmental sustainability across the region. Collaborative work with USDA-ARS and University of Idaho scientists is already yielding insights on manure's long-term effects on soil health and new approaches for nutrient recovery.

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The Idaho Center for Agriculture, Food, and the Environment (CAFE), under construction in Rupert, will be the largest research dairy in the U.S. when milking begins there in early 2026.

Site excavations for the CAFE started in May 2023. Topsoil, which was removed to access rock used for fill at the dairy site, was distributed across the farm fields at the 640-acre CAFE site. This 1 ft of redistributed topsoil will improve the farm fields, according to an article describing the project in the Idaho Dairy Association's *Idaho Dairy Focus.* But crops and soils research is already underway at CAFE, as researchers study the CAFE site's dryland irrigated fields to answer questions that will benefit crop advisers, especially those working alongside the region's dairy industry.

Expanding ongoing research

Milk is Idaho's top agricultural commodity by value of revenue, notching an 11% increase in cash receipts for 2024. And Idaho's dairy herd continues expanding. As of February 2025, it saw a 40,000 cow year-on-year increase, putting Idaho at 700,000 milk cows, eking past Texas to regain third place among U.S. states. Dairy industry expansion is likely to continue. Chobani in March 2025 announced a $500 million expansion at its Twin Falls plant and also made a $1 million contribution toward the CAFE.

As of February 2025, Idaho had 700,000 milk cows, the third highest among U.S. states. This photo shows a rotary milking parlor at the Idaho Center for Agriculture, Food, and the Environment (CAFE) in Rupert, ID. Photo by Savanah Nunes, University of Idaho College of Agricultural and Life Sciences.

The increase of the dairy industry in southern Idaho is also fueling basic and applied agronomic and soils research. "Idaho is a really unique location and climate for dairy production, which is different from other dairy states in the U.S.," says Linda Schott, former University of Idaho Extension specialist of nutrient and waste management. "The sizes of our dairies are large, and they're

irrigated."

Ongoing research at CAFE center pivots

Schott was part of a multidisciplinary research project, conducted on crop fields at the CAFE site, which focused on evapotranspiration (ET). The study included monitoring differences in consumptive water use in mid-elevation spray application (MESA) and low-elevation spray application (LESA) on two center pivots at the CAFE in Rupert.

Research conducted at the CAFE site in Rupert, ID monitored differences in consumptive water use mid-elevation spray application (MESA) and low-elevation spray application (LESA) systems. Photo is not from the research site and is courtesy of NRCS Oregon. CC BY 2.0.

During the 2022 and 2023 seasons, researchers reported, "no noticeable impact of irrigation system on ET." The researchers noted, however, that both MESA and LESA had good moisture levels those years. The LESA field showed greater and longer wetting during the study period. The LESA barley fields also seemed less sensitive to lodging.

The study that compared MESA and LESA at the CAFE site was funded by a NASA Jet Propulsion Lab-Western Water Applications Office grant. There will also be ongoing and additional analysis of soil moisture and crop yield measurements in the CAFE center-pivot fields. Researchers are seeking to understand spatial variability driven by differences in soil depths, one small part of a $10 million USDA National Institute of Food and Agriculture project focused on sustainability in Idaho's dairy industry.

Implications for evapotranspiration data

The main aim of the NASA-funded study, though, was to assess how NASA data products can be used to refine information used in irrigated systems. Specifically, the research at the CAFE site was assessing the ability of satellite-based evapotranspiration (ET) mapping approaches to quantify ET and use long-term ET maps to "identify persistent patterns in consumptive water use."

Evapotranspiration estimates are central when making irrigation decisions. The Idaho team was comparing ET predictions made with the OpenET and GridMET tools. Overall, researchers found the OpenET predictions overestimated ET after irrigation stopped under dry canopy. They also found some bias the GridMET data system. The OpenET tool failed to capture some of the daily changes in ET, but was reliably near the seasonal totals.

Research will continue as the region's industry looks at tools to map persistent patterns in ET to guide variable-rate management. The CAFE center-pivot fields can be viewed with the "Shiny R" tool. Other fields in the Magic Valley are accessible via the GeoServer tool.

Both USDA-NRCS and the Idaho Department of Agriculture are interested in using a persistence mapping tool to target and incentivize variable-rate management practices, according to a presentation by University of Idaho (UI) faculty Erin Brooks and Jason Kelley at the 2024 Western Water Applications Office annual meeting in Boulder, CO.

Building on nearby USDA-ARS manure research

Much of the research at CAFE focuses on nutrient management. "At its core, the primary goal for Idaho CAFE is to answer pressing questions about the dairy industry's environmental impact—questions that revolve around nutrient management, or what

comes out of the back end of the cow," said Michael P. Parrella, former Dean of the UI College of Agricultural and Life Sciences as part of a 2023 announcement about funding for the USDA-ARS Northwest Irrigation and Soils Research Laboratory, which is already involved in analyzing soils research at CAFE.

Take a tour of the Idaho Center for Agriculture, Food, and the Environment (CAFE), courtesy of the University of Idaho ISAID Grant.

The ARS lab is in Kimberly, about 40 miles from the CAFE site. Trials at ARS in Kimberly have already documented the long-term (or legacy) effects of annual dairy manure applications on soil health indicators in Magic Valley soils. Researchers at ARS reported, in a 2024 article in *Agriculture & Environmental Letters*, that dairy manure has a significant effect on SOC up to 30 cm (12 inches). "Manure addition is one of the few ways that SOC can be rapidly increased and potentially sustained in semiarid soils," wrote the authors of the research paper.

Researchers from the Kimberly lab have also published results, in the January–February 2025 issue of *Agronomy Journal*, that showed positive short-term benefits from a one-time incorporation of a heavy dairy manure application via inversion tillage. "Since dairy manure is heavy and associated transportation costs are high, a single high-rate manure application event could be used to negate the need for regularly occurring manure applications," wrote the authors.

That study of one-time incorporation looked at a manure rate of about 45 tons/ac. All soil indicators, except pH, responded positively to a heavy manure application. The main benefit was conservation of organic carbon. That study noted the greatest benefits in the subsoil when the manure was incorporated by moldboard plow tillage. Corn silage yields in the first year after application were lower in the plots where manure was applied than in the control plots, likely the result of the salts associated with additional available nitrogen from the manure, wrote the researchers.

Researchers from the USDA-ARS Northwest Irrigation and Soils Research Laboratory in Kimberly, ID, evaluated the effects of annual dairy manure applications on soil health indicators. Photo is not from the research site and is courtesy of Wikimedia Commons/Brian Forbes. CC BY 2.0.

Research at Kimberly is also looking at legacy phosphorous, from dairy manure applications. That research, published in the *Journal of Environmental Quality* in March 2024, found P was five times more available to plants on soils where manure was applied continuously for eight years at an annual rate of about 23 tons/ac. That research concluded that P drawdown practices—namely, no manure applications—can be adopted for several years without compromising crop yields.

Looking to the future: manure treatments

Research associated with CAFE will also focus on how dairy manure can be treated, on the farm, in ways that reduce potential leaching. The University of Idaho's Sustainable Dairy Initiative is already finding ways to recover nutrients from dairy manure onto biochar, which can be used as a soil amendment. Research results, published in 2024

in the journal *Frontiers in Chemical Engineering*, looked at dairy-waste-treated biochar, which had less than 10% of its total P as water extractable. "Given the reduced extractability of P from the dairy-derived amendments, P losses from the soil will be reduced, leading to improved water quality," the UI researchers reported. Biochar can also add organic carbon to soils, supporting carbon sequestration. Researchers from UI are also looking at batch-reactor production of hydrochar recovered from solid dairy manure.

Research by UI engineers is even looking at turning dairy manure into biodegradable thermoplastic (PHA). Ongoing research reports are available at the Idaho Sustainable Agriculture Initiative for Dairy.

Self-study CEU quiz

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1. According to the article, Idaho's dairy herd increased by how many cows year-on-year as of February 2025?

a. 25,000.

b. 40,000.

c. 55,000.

d. 70,000.

2. Researchers found that evapotranspiration (ET) levels were similar under both MESA and LESA irrigation systems during the study at CAFE.

a. True.

b. False.

3. What was one key finding of the USDA-ARS Kimberly study on one-time heavy manure applications?

a. They reduced all soil health indicators.

b. They lowered soil organic carbon.

c. They improved subsoil organic carbon and most soil indicators.

d. They increased pH and reduced nitrogen availability.

4. What did researchers conclude about phosphorus (P) availability after eight years of continuous manure application?

a. P availability decreased fourfold.

b. P was five times more available to plants.

c. P had no measurable change.

d. P completely leached beyond the root zone.

5. What is one goal of the University of Idaho's research on dairy-waste-treated biochar?

a. To eliminate phosphorus from manure completely.

b. To increase water-extractable phosphorus.

c. To develop a chemical fertilizer replacement.

d. To reduce P losses and improve water quality.

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