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United States Department of Agriculture

National Institute of Food and Agriculture

# SUSTAINABLE DAIRY



SCIENCE FOR SUSTAINABLE PRODUCTION

## Building Sustainable Dairy Systems

Dairy farming in the United States is a multi-billion industry that produces high-quality sources of protein, vitamins and minerals in the form of dairy products to an ever growing world population. While more cows on fewer farms produce an increasing volume of milk, dairy systems may be vulnerable to changes in society and our environment, including climate change.

The production of dairy products contributes about 2% of all greenhouse gas emissions in the US, primarily from the digestive system of the cow, the production of nitrous oxide from soil nitrogen cycling, and the application of manure and commercial fertilizers. The dairy industry, through the Innovation Center for US Dairy, has pledged to reduce greenhouse gases by 25% by the year 2020 by developing and using beneficial management practices on the farm.

## The Sustainable Dairy Project

To better understand how dairy agriculture can become more sustainable, the U.S. Department of Agriculture is investing in a large, collaborative research project to examine dairy production systems across the Great Lakes region. Eight universities, four federal research centers and one business partner comprise the research team of scientists who specialize in soil science, animal science, social sciences, climate science and biosystems and agricultural engineering.

The five-year project focuses on aspects of feed efficiency and feed production, manure processing and energy use, economic aspects of manure handling, water use, nutrient use, and soil quality.

Reductions of greenhouse gas can occur at all stages of production, but the biggest reductions will occur through changes in feed management and manure processing.

As beneficial management practices are implemented across the Great Lakes region, farmers will make dairy production systems increasingly beneficial to the economy, the environment, and society, and consumers will be confident

*Dairy farmers can improve sustainability by implementing beneficial management practices to reduce greenhouse gases without sacrificing productivity or profit.*



Cows produce half of the world's methane gas as part of their multi-chambered digestive system.



Nitrous oxide, an extremely potent greenhouse gas, is emitted during the application of manure and chemical fertilizers.



Extreme weather events like flooding are associated with our changing climate and are occurring more frequently.



Research can determine where on a farm most of the greenhouse gases occur and where changes can be made without sacrificing profit or productivity.

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## Research

Over 50 scientists are involved in the research project. Data are being collected in Wisconsin, New York and Pennsylvania to better understand:

- Feed rations and their effects on methane and milk production;
- Manure storage and alternative processing techniques such as anaerobic digestion and their effects on GHG emissions;
- How changes in diet and manure processing affect the nutrient availability of manure;
- Manure application and rates and their effects on GHG emissions and crop production;
- Water balances and budgets across grain and dairy cropping systems; and
- Cover crops and their influence on carbon and nitrogen cycling.

The measurement team is sharing the data collected with computer modelers whose tasks are to analyze physical, biological and chemical processes that occur on typical dairy farms and to identify where in the life cycle of the farm emissions are greatest. The process models are continually being refined to improve accuracy of greenhouse gas emission predictions and carbon capture rates in soil.

Climate scientists are also using existing global climate models and applying their predictive capabilities to the Great Lakes region. As climate models and process models are integrated, scientists will be able to recommend where in the life cycle of the farm alternative management practices can be implemented to improve resilience.

## Management Tools

Several farm management tools will be available to farmers and their advisors as a result of the Sustainable Dairy project. The first is a refined measurement tool that accounts for emissions for the whole life cycle of the farm. An economic manure management tool examines alternative manure processing systems available to reduce emissions while weighing the costs of each system. Additionally, beneficial management practices will be identified to improve sustainability and resilience to climate change.

Research results will be shared with producers, co-ops, consultants, business groups, Extension agents and students at conferences, one-on-one interactions, and through various web-based tools. Additional information, research findings and extension materials can be found at [www.sustainabledairy.org](http://www.sustainabledairy.org).



Researchers measure greenhouse gases emitted from the soil under different cropping rotations and management practices.



Cows are sequestered in special chambers and the gases they belch are captured and measured. Cow genetics and feed both contribute to how much methane is produced.



Manure collected from cows being fed different diets is captured and spread on soil before crops are grown to better understand how manure processing affects greenhouse gas production and crop performance.



Project Director Dr. Matt Ruark explains measurement data at a field day at Arlington Research Station in Wisconsin.

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