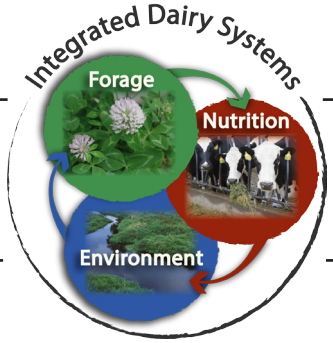
USDA United States Department of Agriculture

Research enhances nitrogen, phosphorus and carbon use on farms



U.S. Dairy Forage Research Center

The goal of much of the research at the U.S. Dairy Forage Research Center (USDFRC) is to enhance nutrient use on the farm. On a dairy farm, this means that more nutrients are used to make milk, not manure. And more of the nutrients in manure are used to fertilize crops, not run off the farm, leach into the ground water, or be lost to the atmosphere.

Why is this important?

This research is important because improved nutrient use leads to benefits for the farmer, the farm, and the environment. Here are some examples:

Farm Profit

- Strategic feeding of dietary crude protein reduces the need for protein supplements which could increase annual farm profits by $60 to $95 per cow per year.
- Keeping more nutrients on the farm through proper manure management reduces fertilizer bills and improves farm aesthetics.

Stewardship

- Practices that reduce nutrient losses also reduce soil erosion and help keep land sustainable for generations to come.

Compliance

- Brings your farm into compliance now, and prepares for additional environmental standards and regulations that are sure to be coming in the future.

Improve Air Quality

- Ammonia (NH_3) forms particulates in the atmosphere that reduce visibility and create a human health hazard; it also prematurely ages natural ecosystems resulting in more fires, among other things.
- Methane ($CH4$) and nitrous oxide (N_2O) are the two major greenhouse gases that are produced on dairy farms, and they contribute to climate change.

Improve Water Quality

- Phosphorus and nitrate nitrogen in surface water runoff end up in lakes and streams where they fertilize plant and algal growth; sometimes this also causes aquatic animals to die due to lack of oxygen.
- Nitrogen leaches to the ground water as nitrates, a potential health hazard.

How does research help enhance nutrient use?

Nitrogen

Research at the USDFRC has shown that feeding protein to dairy cows at levels beyond 16.5% of ration DM results in little to no additional increase in milk production, but does increase the amount of nitrogen excreted in urine and lost to the environment.

Additional USDFRC research has shown that efforts to reduce MUN (milk urea nitrogen) levels in a herd have the added benefit of enhancing profits, improving nitrogen use efficiency, and reducing the amount of nitrogen lost to the environment.

Phosphorus

A USDFRC researcher has developed two computer simulation models, the Annual Phosphorus Loss Estimator (APLE) and APLE-Lots. While APLE is a spreadsheet model that simulates dissolved and sediment-bound phosphorus loss in surface runoff from cropped fields and pastures, APLE-Lots simulates dissolved and sediment-bound phosphorus loss from outdoor cattle lots. Both are being used by other researchers, water quality experts and policy makers to determine the most effective ways to reduce phosphorus runoff from agriculture.




Earlier research at the USDFRC determined that phosphorus could be fed at levels lower than what was recommended at the time, resulting in a significant reduction in phosphorus being lost to the environment.

Carbon

In diets, carbon relates to energy for the cow. Feeding diets balanced for protein and energy enhances profits and reduces methane emissions (belching, products of enteric fermentation).

Bottom line for dairy producers

- Feed rations that are balanced in energy (carbohydrates) and protein. This can be monitored using MUN (milk urea nitrogen).
- Don't overfeed phosphorus. Current NRC recommendation is 0.38% of diet DM for healthy, high-producing dairy cows.
- Maintain MUN levels in the herd at 10-12 (mg urea/100 ml milk).
- Collect manure and make good use of its nutrients. Properly store and spread.
- Large dairies can capture methane from manure storage to produce electricity to be used on the farm or sold.
- Use no-till methods to increase carbon sequestration in the soil.
- Manage silage bunkers and piles well by packing, covering, and keeping a clean face.
- Use cropping practices, such as cover crops, crop rotation with perennials, and pastures, to reduce soil erosion.
- Use conservation practices, such as buffer strips, terraces and strip cropping, to reduce soil erosion.

How do N, P, and C enter the atmosphere, surface water, and ground water?

Ammonia gas (NH_3) is volatilized from:

- Manure in barns and storage
- Silage bunkers and piles
- Manure applied to soils

Nitrogen is transformed to nitrous oxide gas (N_2O) in the soil and then emitted. The nitrogen sources are:

- Inorganic fertilizer on crops and pastures
- Manure on crops and pastures
- Legume-fixed nitrogen in soil

Nitrogen is transformed to nitrate (NO_3^-) in the soil. The nitrogen sources are:

- Inorganic fertilizer on crops and pastures
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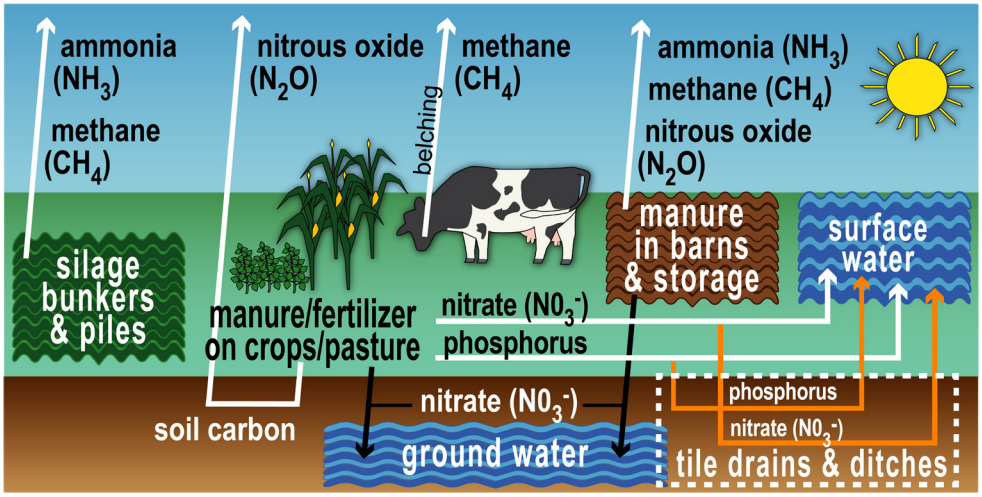
- Legume-fixed nitrogen in soil



Phosphorus dissolves in runoff water or attaches itself to soil particles that might erode. Phosphorus comes from:

- Inorganic fertilizer on crops and pasture
- Manure on crops and pastures

Methane gas (CH_4) is emitted from:

- Enteric fermentation by cows/belching
- Manure storage
- Silage bunker and piles

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