In the Dairy Forage Arena, Publicly Funded Research Can Pay Big Dividends

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How can one determine the value of public research? Every issue of Forage Focus is filled with articles about current research projects designed to improve forage systems. Forage producers understand the value it brings to their farms. But can a dollar amount be attached to this value?

The U.S. Dairy Forage Research Center (USDA-ARS) has been conducting dairy forage research for 30 years at its main location in Madison, WI; its research farm in Prairie du Sac, WI; and, since 2007, at the Institute for Environmentally Integrated Dairy Management in Marshfield, WI. Recently, its scientists set out to determine the dollars and cents value of some of its major research projects, and they came up with a whopping $1.5 billion saved annually by dairy and forage producers. On top of that, much of the research also has environmental outcomes that benefit all of society.

So how did they arrive at the $1.5 billion figure? Here are five examples that were studied. The scientists realize that an exact dollar figure cannot be determined; but estimates were calculated based on scientific data and with reasonable assumptions as to the extent that new practices have been adopted by farmers. They also acknowledge that their research was not conducted single handedly; they collaborate with many other public and private research organizations, and they build on the knowledge of past research. Still, the value of research – conducted at the U.S. Dairy Forage Research Center in the past 30 years or conducted at other times and places – cannot be denied.

Eliminating Excessive Protein

Dairy farmers have fed high levels of protein as a "risk management" strategy to avoid the chance of reduced milk production, due to inadequate dietary protein. In the late 1990s, many high-producing dairy herds were being fed diets at more than 20% protein, with much of that protein coming from purchased feed, such as soybean meal.

These high levels of protein were costing dairy producers lots of money. Additionally, when cows were fed more protein than they could use, the excess was excreted as urinary nitrogen, and this created a greater potential for 1) nitrogen to leach into groundwater when manure was spread on farm fields and for 2) ammonia nitrogen to volatilize to the atmosphere.

Research at the Center sought to determine the optimal amount of protein needed in the diets of high-producing dairy cows. Results of a number of studies showed that there were no further increases in milk production per cow when feeding protein at levels greater than 16.5% of the diet.

Farmer surveys have shown that Wisconsin dairy producers with the highest levels of milk production have reduced the average protein content of their dairy cattle diets by nearly 2% from 1998-2005. If extrapolated to the entire U.S. dairy herd, this would translate into an annual savings of $740 million [based on 9.1 million dairy cows (NASS, 2010) consuming 50 lbs DM/day, over a 305-day lactation, and soybean meal at $300/ton]. It would also mean that less nitrogen from manure is finding its way into groundwater and the atmosphere.

This reduction in dietary protein has reduced the nitrogen output in manure (especially urine, the source of ammonia) by more than 15%. Reduced manure nitrogen due to improved feeding decreases ammonia emission from barn floors by 15% and land spreading by as much as 50%.

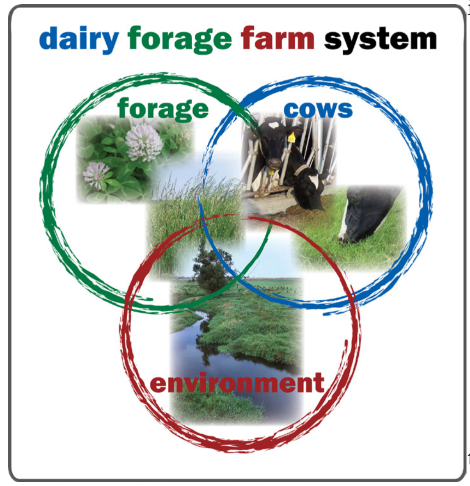
Reducing Phosphorus

Historically, dairy farmers tended to "err on the high side" when feeding minerals and fertilizing fields because minerals such as phosphorus were cheap and the environmental consequences were unknown. However, when excessive amounts of phosphorus in surface water became an environmental policy concern in the 1990s, runoff from farm fields was cited as a major contributor. At that time, surveys indicated that U.S. dairy producers were feeding lactating cows in excess of the recommended amount of phosphorus. Strong beliefs that extra dietary phosphorus improved reproduction (held by nutritionists, veterinarians, and producers) encouraged excessive feeding just to be on the "safe side."

Researchers at the Center challenged this long-held belief by conducting a large-scale study of 267 early-lactation cows. This study unequivocally demonstrated that feeding phosphorus in excess of recommendations did not improve milk production or reproductive performance. Companion field trials demonstrated that reduced phosphorus feeding also reduced runoff phosphorus.

The convincing conclusions from these experiments contributed greatly to reductions of dietary phosphorus in the U.S. dairy herd. Results of local surveys, analyses of total mixed rations submitted to testing laboratories, and feedback from extension specialists and the feed industry suggest that the level of dietary phosphorus fed to the U.S. herd had been reduced from an average of about 0.48% in 1999 to about 0.40-0.42% presently. This reduction in dietary phosphorus has saved the U.S. dairy industry an estimated $109-$182 million annually [based on 9.1 million total dairy cows in the U.S. (NASS, 2010) and an annual savings of $12-$20 per lactating cow in reduced mineral purchases].

This reduction in dietary phosphorus has reduced the phosphorus content of manure by about 15-20%. These reductions translate to about 27% less phosphorus in runoff from manure after it is applied to the land. The value of improved water quality due to reduced phosphorus runoff is enormous. Feeding less phosphorus also means that less acreage is required to spread dairy manure, thereby helping dairy producers meet new manure land spreading standards.



The U.S. Dairy Forage Research Center is marking its 30th anniversary in 2011. Much of the Center's research is focused on improving the economic and environmental sustainability of dairy forage farm systems.

Less Feed Loss in Bunkers

As dairy producers made a major shift to ensiling feed in large bunkers and piles, more feed was being lost to spoilage and decomposition. How could these losses be reduced without losing the efficiencies gained from bunker silo usage?

A collaborative effort between the Center, the University of Wisconsin, and county extension agents surveyed bunker silo management practices and densities across Wisconsin. The range in densities varied by a factor of three from the lowest to highest densities, a much wider range than expected. The survey indicated which practices were important to achieving a high density, led to spreadsheet tools to help farmers obtain high silage densities, and sparked an interest across the U.S. in silage density. The spreadsheets are now available in three languages and are used around the world.

Silage scientists have long recognized the importance of covering a silo well to minimize losses, but at one time, less than half of U.S. bunker or pile silos were covered. Research on silo covers at the Center and in other states has demonstrated the value of covering and has compared the merits of different types of covers. The 2009 Hoard's Dairyman Continuing Market Study found that, today, more than 93% of dairy farmers cover their bunkers.

What is the economic impact of this research? With well-managed bunker and pile silos, as little as 10% of feed is lost; with poorly managed bunkers and piles, losses can be as high as 40%. Every ton of as-fed silage saved is worth $30-$80, depending on type and quality. In the U.S. livestock industry, reducing feed losses from bunker and pile silage by 5% translates to an annual savings of about $150 million [assumes alfalfa and corn silage at $60 and $40/ton respectively; also assumes that, of the silage made in the U.S in 2009 (32 and 108 million tons; NASS), half was in bunkers or piles].

When silage quality improves due to improved packing density and covering, there is also an increase in the amount of protein in the feed that is available to the cow. Therefore, less nitrogen is excreted in the manure to potentially find its way into soil, air, and groundwater.

Improving Grazing-Based Dairy Systems

In the late 20th Century, pasture-based dairy production began to grow due to economic considerations and consumer demand. However, few grass and legume varieties were designed for managed intensive rotational grazing systems. And less was known about managing grasses and legumes in pasture-based systems, compared to haymaking systems.

The Center helped to fill this void by adding two new research positions and refocusing a third position in order to meet the rising public demand for research on grass-based systems. The Center is breeding new pasture varieties (legumes and grasses) and conducting pasture research that has resulted in specific management guidelines graziers use to improve productivity, utilization, and profitability.

Plant breeders at the Center currently have 3 grass and 7 legume varieties and germplasms in some stage of commercial development; these should be available to farmers between 2012-2016. These new varieties of grasses and legumes with improved digestibility or persistence will allow grazing-based dairy cows to produce about $130 million in more milk annually [based on 50,000 acs of improved pasture, a 5% increase in digestibility leading to 8 lbs more milk/cow/day, 15 cows/ac, 150 days of grazing, and milk at $14.50/100 lbs]. The value of the extra pasture grass available to cows, when improved management practices are implemented, is about $120 million annually for all U.S. grazing-based dairy farms [based on a 20% increase in pasture DM (800 lbs/ac) valued at $9.25/100 lbs or $74/ac and 8,145 grazing-based dairies averaging 200 ac of pasture]. In addition, low-input, low-capital pasture-based systems are an excellent way for young people to begin dairying.

Better Feed Analysis

For dairy producers to make the best use of homegrown forage and minimize purchased feeds, they need a system to accurately analyze feeds and blend them in a way to meet the energy and nutrient needs of the cow. This is particularly difficult with fiber from forage, which is a major source of carbohydrates (energy) to the cow and is also critical for its physical function. However, fiber is the portion of a feed that is the most variable in digestibility to the cow, which makes it a challenge to analyze.

Research at the Center standardized the technique to reliably measure neutral detergent fiber (NDF) in a wide variety of feeds and was able to publish it as an official method that forage testing laboratories can use. In addition, a system for formulating dairy rations (the NDF-Energy Intake System) was developed to maximize forage use while promoting maximum milk production. And the concept of physically-effective NDF was created, combining the chemical and physical properties of fiber to meet the minimum fiber requirements of the cow.

A 5% improvement in the estimation of the energy value of feeds, if used to formulate improved rations for the lactating dairy cows in the U.S., increases efficiency and/or productivity by $260 million annually [based on 9.1 million dairy cows (NASS, 2010) consuming 1 lb less DM/day and a mixed ration costing $140/ton]. Every time rations are balanced effectively, feed utilization and efficiency improves, less undigested feed leaves the cow as manure, and fewer acres are needed per pound of milk produced to grow the cow's rations.