

The Role of the Dairy Industry in Protecting Surface Water Quality

University of Wisconsin

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The logo for Discovery Farms is a circular emblem. It features a stylized green tree with a white trunk, set against a light green background. Below the tree, there is a blue wavy line representing water. The entire emblem is enclosed within a green circular border.

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Introduction

Wisconsin's economy is highly dependent on the forty billion dollars generated annually through agricultural industries. Agricultural production, manufacturing and marketing are responsible for the creation of thousands of jobs, allow for the management of over nine million acres of tillable land and, in many ways, are a major factor in the tourism industry. A discussion of Wisconsin's economy cannot take place without recognizing the continued economic impact of agriculture.

The dairy industry is the cornerstone of Wisconsin's agriculture and is one of this state's most recognizable industries. Wisconsin's dairy products are known for high quality and wholesomeness and are in demand throughout the country. Though the state no longer leads the nation in the production of milk and dairy products, Wisconsin remains one of the leading milk producing states. But what is it about Wisconsin that encouraged the growth and development of the dairy industry? One hundred years after the development of this industry, how has the dairy industry impacted Wisconsin's environment?

The purpose of this paper is to outline how the dairy industry impacts Wisconsin's environment and rural character. Our goal is to recognize that while dairying may have some environmental risks, when done properly and in the right settings, dairying can actually enhance environmental protection of our surface water resources.

Wisconsin's Dairy History

When Wisconsin was first settled and agriculture began, the state was known for its production of wheat. Early settlers had a history of wheat production, so they were familiar with how to produce and store the crop. Wheat required little maintenance so that farmers were able to plant it and then work on clearing land and making fences for livestock. Around 1860, wheat production peaked with over 27 million bushels produced. However, after years of wheat production, the soils became depleted of nutrients and plant diseases and pests were more prevalent.

By the late 1870s, wheat farming had run its course in southern Wisconsin and farming had to become diversified. The production of corn and oats as cash crops increased dramatically. In 1849, corn and oats production was at just over 5 million bushels compared to over 67 million bushels produced in 1879. The production of hay was also increasing during the same period with 275,000 tons produced in 1849 compared to 1,907,000 tons in 1879. The land that could produce abundant yields of wheat was ideally suited to produce forage crops and corn. In addition, the large acreage that was unsuitable for cultivation was well suited for pasturing livestock.

Wisconsin was blessed with a great climate that included nearly ideal average temperatures and adequate annual rainfall. The annual precipitation made it possible to produce feed on a variety of soils without irrigation and the state possessed adequate land for the application of manure generated by the animals. The ability to produce abundant forage yields without irrigation and to supply valuable nutrients to crops through manure was critical in terms of long-term sustainability. A final consideration was the vast supply of both surface and groundwater, which provided water to the animals and cooled the milk.

This state was also blessed with farmers who knew and understood dairy cattle, the dairy industry and produced milk economically. Wisconsin's rise as a leader in dairying can be traced back to key factors including: developing professional dairy associations, scientific discoveries by the University of Wisconsin College of Agriculture and cooperation of farmers in executing dairy plans and policies. Dairying grew rapidly. Consider that in 1867 Wisconsin had 245,000 dairy cows and by 1912 that cow

number was 1,460,000. Perhaps a greater indication of the increase in dairying is that in 1869 the state produced 3 million pounds of cheese and within ten years that amount quadrupled. Wisconsin is America's Dairyland!

Agriculture continued to grow throughout the early twentieth century. Milk cow numbers peaked around 1945, with the state boasting about a dairy herd of 2,360,000 cows and the total land owned by farmers was around 23,600,000 acres. The dairy industry developed not only because of the climate and farmers, but because it was supported by a number of manufacturing plants (cheese, butter, yogurt, specialty products, etc.), a large and diverse supply industry (feed, fertilizer, veterinarians, builders, etc.) and a strong marketing infrastructure. The growth of the dairy industry was staggering, but as with most industries, the dairy industry was approaching a period of maturity and consolidation.

Today's Dairy Industry

Wisconsin's dairy industry is in a period of transition. While cow numbers peaked at 2.3 million head in the 1940's, the state herd in 2002 had decreased by almost 47%. Today, Wisconsin is home to about 1.3 million cows making up 17,000 herds in almost every county of the state. While we have one of the top dairy infrastructures in the world, the dairy industry is concerned about a diminishing supply of milk and aging facilities.

The dairy industry is showing signs of growth and renewal. Producers are transitioning from their old facilities to new, less labor-intensive facilities. Families are joining together to operate larger multi-family farms that are more efficient and provide greater opportunities for producers to have more time off and better growth potential for themselves and their families. Dairy producers are developing niche markets, selling organic products, and involving themselves in direct marketing and any number of other innovative dairy systems.

Wisconsin's dairy herds are being grazed, raised on small single operator farms, or on the growing number of mid-size operations that are improving or expanding their facilities to meet the challenges of the 21st century. There is also a small percentage of the dairy industry that is investing millions of dollars in facilities and land to develop large dairy operations that can produce the high volumes of milk required to replace the loss of cows and production that have left our state. Each of these operations can and will contribute to our economy. These operations will also play an important role in the protection and enhancement of Wisconsin's environment and can aid in the protection of our valuable ground and surface water.

Dairying and environmental protection

Dairy farming has been and will continue to be one of agriculture's leading industries in terms of protecting and enhancing surface water quality. Dairy systems offer land use flexibility and allow for significant diversity of crop production. Dairy operations have the ability to:

- Combine animal production with crop production,
- Protect sensitive landscapes with perennial forages,
- Provide a mixture of both perennial crops and annual crops,
- Allow for the production of both grass plants and broadleaf plants,
- Recycle the nutrients contained in the manure generated, and
- Complement and support other farming systems.

Dairy systems fit well onto Wisconsin's diverse landscapes. When properly managed, dairy systems minimize soil erosion, reduce purchases of commercial fertilizer and pesticides and improve the cycle of nutrients within the crop and animal enterprises. Soil erosion can impact surface water quality

through the delivery of sediment, nutrients and pathogens to the water system. Sediment carries phosphorus to a fresh water system that is normally deficient in phosphorus. Higher levels of phosphorus promote the production of aquatic weeds and algae and make the recreational use of surface water less desirable. A greater concern of the increased growth of algae and aquatic weeds is that when they die, the decomposition of these products decreases oxygen levels in the water. This decrease in oxygen can kill fish.

Wisconsin dairy producers normally produced most of the feed for their operations, which means that they grow a variety of forage and grain crops to sustain their herd for a period of one year. Dairy systems are more diverse and generally less erosive than other farming systems because they include the maintenance of perennial forages. Dairy cropping systems also cycle on-farm nutrient sources (N-P-K) in the form of rotated legume crops and livestock manure.

Dairies environmental challenges

While dairy systems can provide environmental protection, there are some unique challenges that accompany these farming systems. These challenges include:

- ✓ Corn silage is being harvested on more operations because nutritionists have recognized value in the energy and fiber provided by the crop. A number of operations have also increased the number of acres harvested as silage because of increased dry matter yields compared to hay production. When corn is harvested as silage, the entire plant is removed, leaving little crop residue remaining on the field. Crop residue protects the soil from the impact of raindrops and greatly reduces soil erosion potential.
- ✓ Removing crop residue also occurs when corn stalks or soybean stubble are harvested for bedding. The harvest of this residue provides valuable bedding for cattle. When left on the field, this residue would provide critical protection for the soil.
- ✓ Hay production has shifted from grass/legume mixtures to more pure alfalfa stands. Eliminating grasses from alfalfa hay fields removes the sod forming benefits of grass root systems and increases soil erosion potential. Alfalfa taproots provide limited soil protection in the early spring and immediately after harvest.
- ✓ Establishing hay crops using direct seeding of alfalfa increases soil erosion potential due to the slow growth of the alfalfa and the long period of time required to establish the alfalfa plant.
- ✓ Misapplication of both liquid and solid dairy manure pose threats to both surface and groundwater.

Possible environmental solutions

Again, these challenges can be viewed as manageable because of the flexibility present in dairy systems. Each of the issues identified above can be mitigated using the following practices:

- ❖ Dairy producers have begun to establish cover crops after corn silage to help reduce soil losses. This requires planting proper hybrids so that cover crops have adequate time to become established prior to a killing frost. Another practice is to plant short season corn hybrids followed by fall seeding of a perennial forage crop. Producers can also increase the cutting height to increase the residue remaining. Harvesting corn silage on non-highly erodible land is also recommended. Selecting corn silage fields with care can insure that the potential for soil erosion is minimal.
- ❖ The use of sand, mattresses and other inorganic bedding materials are also ways that producers can reduce their use of corn and soybean residues.
- ❖ Research at the Marshfield Ag Research Station indicates that grasses may have higher digestible fiber than some legumes, thus making grass a more acceptable forage. As this

research develops, mixing grasses with alfalfa and other legumes may again become more common. This would provide better protection against soil erosion than pure alfalfa stands.

- ❖ Many dairy producers use a nurse crop to protect the soil from erosion while alfalfa is being established and then harvest it as silage or use either herbicides or clipping to kill it. This practice allows for quick development of the nurse crop but also allows the alfalfa to have minimum competition during the growth stage.
- ❖ Dairy manure is a valuable on-farm resource that can be used to meet crop nutrient needs. Using current commercial fertilizer prices, solid dairy manure is worth \$2.27 per ton and liquid dairy manure is worth \$4.75 per 1,000 gallons. These values are based on nutrient content and do not account for storage, handling, application and labor costs. Properly applied dairy manure can enhance soil quality and minimize the opportunity for nutrient enriched sediment and runoff water to leave cropland and enter surface waters. Surface applied manure contributes organic matter to the soil surface and can function as residue to minimize soil erosion.

Managing Dairies for Environmental Protection

The vast majority of environmental challenges faced by dairy producers can be managed if they develop and implement two key conservation practices:

1. A soil conservation plan that gets all fields to tolerable soil loss levels,
2. A nutrient management plan that meets the NRCS 590 standard.

In fact, because of the flexibility provided by dairy cropping systems, many dairies are able to provide a greater level of environmental protection than if they were not producing milk. To evaluate these cropping systems, the UW-Discovery Farms Program studied how three cooperating dairy farms manage cropping systems within their livestock enterprise. These farms are unique and located upon three different physiographic settings within the state. They also operate at different degrees of land use intensity.

General farm information

There are many differences on these farms including: landscape, housing, feeding, manure handling, crop choices, use of tillage, bedding, field configurations and placing of crops upon the farm landscape. As these operations are discussed, the reader should note that the greatest differences between these operations are in terms of tillage, soils and slope, crop rotations, manure types and application methods.

Farm 1 is a diversified dairy and livestock operation that has a 180-cow dairy and three other livestock operations. It is located in the driftless region of the state and is very representative of the operations located on the western edge of Wisconsin. Field slopes average 12 % and tolerable soil loss (T) ranges from 3 to 5 tons per acre per year. Crops include corn grain, corn silage, soybeans, alfalfa, wheat and sorghum sudan grass and are established using no-till methods. The steepest slopes of the farm are maintained in hay and corn rotations. Other portions of the farm, which are not nearly as steep, are managed using a no-till corn and soybean rotation. Many farm operations in western Wisconsin are multi-species and many have a cash grain component in addition to the livestock enterprise.

Farm 2 is an organic 120-cow dairy that has a rotation of corn, small grain and alfalfa that is run on the cropland acres. In order to farm organically, this farm uses a mix of traditional and conservation tillage practices including moldboard plowing, disking and field cultivating. Weeds are controlled by timed tillage before planting and cultivation after the crops are planted. The cropland is located on the ridges of the farm away from a stream that transverses through the center of the operation. The remaining land (200 acres) is permanent rotationally grazed pasture with the stream dividing the

pastures. Cropland slopes average 8 % and tolerable soil loss (T) ranges from 4 to 5 tons per acre per year.

Farm 3 is a central Wisconsin dairy system that is a management intensive rotational grazing dairy (MIG). The farm runs 80 cows and has the entire 210 acres in permanent grass pastures. The pastureland is divided into smaller paddocks and the average slope is 4 %. Tolerable soil loss (T) ranges from 4 to 5 tons per acre per year. This operation purchases additional corn silage, grain, and hay from off the farm and produces no additional crops other than pasture. This operation has the lowest soil losses for a couple of reasons. First the farm has very little highly erodible land (HEL) and the average slopes on this operation are either one third or one half as much as the other operations. The second reason for the lower soil loss estimates is that the entire land mass is in grass and no tillage occurs.

Soil conservation planning

Table 1 summarizes average soil loss estimates for each farm’s current cropping system. Soil loss was estimated using the USDA – RUSLE2 model. Results are averages from all fields on individual farms.

Table 1. *Cropping practices and the effect on predicted soil loss using the RUSLE2 soil loss equation on three Wisconsin dairy farms.*

Farm	Actual Crop Practices	Avg. Soil Loss Ton/Ac/Yr
1	Corn Grain – Soybean (ridge) Corn Silage – Alfalfa (4) (valley)	5.7
2	Corn Grain -Oat/A-(3) Alfalfa Corn Grain(Spring Tillage - 20%) Oat/A (Spring Tillage-0%)	1.1
3	Managed Intensive Grazing	0.4

Estimated soil loss is highest (5.7 tons per acre per year) on Farm 1, which is the steepest farm. Soil loss on this operation is a function of the steep topography, and the establishment of larger fields that are farmed on the contour. The cropping system is at the point where field management on the steepest land results in an estimated soil loss level greater than T. These fields are located on the top perimeter of the valley farmland, just below the very steep woodland separating the valley from ridge top fields. Many of these fields have slopes in excess of 20 %. The valley farmland supports feed and forage needs for the dairy. The ridge farmland is operated in a corn – soybean crop rotation.

To maintain tolerable erosion rates on the steepest fields, implementing any or all of the following crop management techniques could modify this farming system:

- ✓ Include a variety of late maturing forage grass with new seeding alfalfa. A legume / grass mix would diversify the crop root zone, forming a fibrous root + tap root sod, and bind the soil together to provide more resistance from the erosive power of rainstorms.
- ✓ Explore use of small grain cover crops for hay establishment on steep fields. The small grain crop could either be utilized for forage or burned back with an appropriate herbicide. In either case, crop canopy cover would develop quickly and minimize soil erosion caused by early season raindrop impact.
- ✓ Minimize corn silage harvest from steep areas by planning for corn to be harvested as grain. Corn stalks left in place until the next spring provide protective residue over the soil surface minimizing soil erosion by absorbing raindrop impact energy.

- ✓ Re-establish contour strips on steepest areas below the tree line. Even though the land is farmed on the contour now, additional soil conservation benefit could be gained by breaking slope lengths up with alternating strips of hay and corn or new seeding. Contour strips would need to be sized and configured to not only treat the landscape but also to accommodate the size and maneuverability of field equipment.

These four management changes would reduce the soil erosion potential and provide the producer with a soil conservation plan that meets tolerable soil loss levels and reduces sediment movement. Implementing one or more of these management practices could modify the current cropping system and the feed supply for the dairy could be enhanced.

Estimated soil loss on Farm 2 is well below tolerable soil loss levels (1.1 tons per acre per year), even though this operation has the most intensive tillage system. Here, the topography, field configuration and crop establishment practices greatly influence the predicted soil loss levels. The affects of the tillage is offset because this operation establishes an alfalfa / grass hay mix using small grain cover crops. A second factor is that this farm is currently not harvesting corn silage, but this practice could be dealt with by harvesting only on non-highly erodible land. This farm uses a mix of traditional and conservation tillage, often burying most of the previous crop residue due to a reliance on tillage for weed control. Another influencing factor is that most cropland is moderately sloping with contour strip field configurations, alternating hay with either corn or new seeding hay.

Estimated soil loss on Farm 3 is far below the tolerable levels (0.4 tons per acre per year). The operation utilizes its entire land base as a managed intensive grazing forage system. No row crops are grown on this farm, and the only tillage that occurs is to periodically re-seed areas within the paddock system. However, this operation does utilize purchased feed and imports nutrients from off farm sources.

In order to determine how these dairy systems are impacting the environment, the UW – Discovery Farms Program has installed surface water monitoring equipment on each of these operations. This equipment monitors nutrient and sediment losses from each operation and allows for the determination of the dairies impact on the environment. Once the actual nutrient and sediment losses are established, if any changes in the dairy system are necessary, they can be implemented and monitored.

What happens if the cows are sold?

Many people associated with soil conservation and environmental protection are concerned that if the trend of selling the cows and moving to cash grain production does not cease, soil erosion and nutrient losses will increase. Table 2 summarizes predicted average soil loss for the three example farms and evaluates what happens to soil losses if these farms shift land use to a corn and soybean crop rotation.

As indicated in Table 2, having a crop rotation that includes forages benefits all the operations in terms of reducing soil erosion. On Farm 1 average soil loss increases to 8.3 tons per acre per year using a no-till planting system and increases to 10.7 tons per year using a conservation tillage system. The farm would have 180 acres (23%) and 102 acres (13%) that meet the tolerable soil loss planning goals using these types of planting systems if the forage crops were removed from the crop rotation.

Table 2. *Cropping practices and the effects on predicted soil loss using the RUSLE 2 soil loss equation on three Wisconsin dairy farms.*

Farm	Scenario	Cropping Practices	Avg Soil Loss/Ac/Yr	Acres > T	Acres < T	Total Tons > T	Total Tons of Soil Loss
1	Actual	Corn Grain - Soybean on ridge land. Corn Silage - (4) Alf on valley land	5.7	525	253	2184	4671
	Shift to C-SB	Corn Grain-Soybeans Corn (No-till - 50%) Soybeans (No-till - 50% narrow)	8.3	597	180	3863	6609
	Shift to C-SB	Corn Grain-Soybeans Corn Grain (Spring Tillage- 30%) Soybeans (Spring Tillage - 30%)	10.7	675	102	5831	8644
2	Actual	Corn Grain -Oat/A-(3) Alf Corn Grain (Spring Tillage - 20%). Oat/A (Spring Tillage - 0%)	1.1	0	263	0	273
	Shift to C-SB	Corn Grain-Soybeans Corn (No-till - 50%) Soybeans (No-till - 50% narrow)	3.8	18	245	20	930
	Shift to C-SB	Corn Grain-Soybeans Corn Grain (Spring Tillage - 30%) Soybeans (Spring Tillage - 30%)	5.0	147	116	111	1222
3	Actual	Managed Intensive Grazing (MIG)	0.4	0	196	0	80
	Shift to C-SB	Corn Grain-Soybeans Corn (No-till - 50%) Soybeans (No-till - 50% narrow)	1.4	0	196	0	278
	Shift to C-SB	Corn Grain-Soybeans Corn Grain (Spring Tillage - 30%) Soybeans (Spring Tillage - 30%)	2.4	9	186	7	498

While Farm 2 is not as steeply sloped, it still has a rolling topography. The moderately sloping landscape is more accommodating to a corn and soybean crop rotation as long as a number of soil conservation practices are in place. This operation could maintain a whole farm average soil loss of 3.8 tons per acre per year (93% of the land is at T), using a no-till planting system and 5.0 tons per year using conservation tillage (44% of the tillable land is at tolerable soil loss levels).

The gently sloping landscape of Farm 3 is most accommodating to a corn and soybean crop rotation. Whole farm average soil loss increases to 1.4 tons per acre per year if the operation were to switch from grazing to a corn and soybean rotation using a no-till planting system (100% still at tolerable levels). If conventional tillage was used (30 % residue at planting), soil loss increases to 2.4 tons per acre per year, which is still below tolerable levels (95% of the land is below T).

The Benefits of Nutrient Management Planning

The second key to managing operations for environmental benefits is to develop and implement a sound nutrient management plan. Nutrient management is defined within the USDA-NRCS 590 standard as “managing the amount, source, placement, form and timing of nutrient and soil amendment applications”. Nutrient management planning provides a structured method to account for nutrients contained within commercial fertilizer, livestock manure, rotated legume crops and properly budget to meet crop nutrient needs. Along with efficiently supplying crop nutrition, a properly implemented nutrient management plan minimizes nutrient entry into surface and groundwater while maintaining and improving the physical, chemical and biological condition of the soil.

Livestock manure and rotated alfalfa / grass hay crops provide significant quantities of on-farm N – P₂O₅ and K₂O for dairy operations to manage and utilize, thus reducing their reliance on commercial fertilizers.

Table 3 shows a scenario with 100 cows. Manure is stored in a concrete lined pit, applied to the field and incorporated into the soil within 3 days of application. About 50 acres of alfalfa / grass hay is rotated to corn annually and this provides a legume credit of about 120 lbs of nitrogen per acre. This farm has the potential to generate 11,680 lbs of N - 5,840 lbs P₂O₅ and 18,688 lbs K₂O from livestock manure and an additional 6,000 lbs of legume nitrogen credit. Using current commercial fertilizer prices, these nutrients are worth a total of \$7,544, annually. These numbers would increase upon accounting for young stock that would likely be present on a farm of this size.

Table 3. *Nutrient quantities and values -100 milk cows and 50 acres of rotated alfalfa/grass hay.*

On – Farm Nutrients	N	P ₂ O ₅	K ₂ O
Manure *	11,680	5,840	18,688
Legume credit **	6,000	0	0
Total	17,680	5,840	18,688
Value (\$) ***	\$3,713	\$1,404	\$2,429

* 100 mature milk cows generate approx. 1,168,000 gal. of liquid manure + waste water each year. University of Wisconsin – Extension book value nutrient credit for incorporated liquid dairy manure is 10 N – 5 P₂O₅ – 16 K₂O / 1,000 gallons

** University of Wisconsin – Extension N credit recommendation for fair alfalfa grown on medium textured soils, cut in the fall is 120 lbs N / acre.

*** \$0.21 / lb N. \$0.24 / lb P₂O₅. \$0.13 / lb K₂O.

Nutrient management planning on agricultural operations provides three basic benefits. First, properly considering crop nutrient needs on individual fields and then supplying the correct mix of on-farm nutrients (livestock manure, rotated legume crops) plus commercial fertilizer assures profitable yields. Second, inventorying and accounting for on-farm nutrient sources allows for efficient business decisions when considering commercial fertilizer purchases. Finally, proper evaluation of crop nutrient needs and responding with the correct best management practices of crediting, rates, placements and timings helps keep excess nutrients out of the water system and enhances a farm’s public relations.

The flexibility provided by dairying

Wisconsin’s landscape and dairy farming can provide a number of positive synergies. If managed to minimize soil erosion and provide the nutrient needs of the crops, dairying can help protect our precious water resources. The issues of Wisconsin’s diverse topography and soils along with changes within the dairy industry have created new challenges for the dairy industry. However, the dairy industry is fortunate in that it has flexibilities provided through crop rotation and manure application to minimize these challenges.

Not all landscapes are created equal, and the dairy industry in Wisconsin is just as diverse. One advantage dairies have is the ability to move crops around on the landscape. More sensitive fields can be rotated away from row crops and planted to hay and other forage crops. Where a farm has less sensitive lands that can accommodate a more intense rotation, the farm should use these fields for corn silage and the harvest of bedding as necessary. The less sensitive fields can also be used to apply manure and other organic by-products during periods of sensitivity (frozen or snow-covered ground).

In landscapes where much of the land is sensitive, dairy operations still have the flexibility to adjust crop management and in some cases even explore different farming practices (grazing, no-till, etc.).

Conclusions

Wisconsin has a lot of land that is well suited for intensive row crops, vegetable crops and specialty crop production. This land can be operated using cropping systems that control nutrient, sediment and pesticide losses, while maintaining or enhancing profitability. Cash grain producers and dairy producers can have a very beneficial symbiotic relationship by sharing resources with each other. The loss of the dairy industry would reduce the markets for grains and have a tremendous impact on the entire agricultural community.

Wisconsin is fortunate to have a diversified dairy industry that includes many different types of dairy operations. Producers have adopted their farming systems to accommodate their physiographic settings, their labor and management resources and their personal goals. This blend of dairy systems supports a dairy economy that is crucial to the long-term economic success of our state. While the dairy industry is still in a period of transition, dairying can still be an important part of ensuring that Wisconsin water resources are protected and enhanced for generations to come.

The basics of the dairy industry have remained constant for the past 125 years, dairy cattle need:

- ✓ People who know and care for dairy animals,
- ✓ An environment that is clean, dry and has adequate ventilation,
- ✓ A supply of clean water for the animals,
- ✓ Large quantities of high quality forages,
- ✓ An adequate supply of grain or by-products to supply energy in the diet, and
- ✓ Adequate land to recycle the nutrients contained in the manure.

Wisconsin still has all of these characteristics, and while the industry has changed drastically in the past twenty years, with proper management it can still benefit society and our environment.

The dairy industry needs to continue to improve not the only production of milk, but also the adoption of production practices that protect and enhance our environment. Producers and consumers need a better understanding of the role of the dairy industry in reducing soil erosion, protecting streams and lakes from sediment and nutrients and the ability of the dairy system to recycle nutrients and reduce agriculture's reliance on purchased herbicides and fertilizers. To aid both consumers and producers in understanding these systems, the University of Wisconsin – Discovery Farms Program is committed to working with producers, agencies, policy makers, researchers and others to: “Determine the impacts of production agriculture on the environment, while learning the economic and environmental ramifications of adopting Best Management Practices on a diverse group of Wisconsin farms”.

By fully understanding these farming systems, the affects of different systems on our environment and the impact of adopting best management practices on both the environment and farm profitability, we can help the dairy industry and other agricultural industries remain profitable and productive in Wisconsin.