

STRATEGIES FOR INCREASING IMPLEMENTATION AND FOSTERING INNOVATION IN DAIRY MANURE MANAGEMENT

A Report Prepared By:

NATIONAL DAIRY ENVIRONMENTAL STEWARDSHIP COUNCIL

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Executive Summary

Dairies in the U.S. are under increased pressure to address air and water quality impacts from manure, while simultaneously providing milk products to a growing population. Since the 1950s, the U.S. population has almost doubled and consumer demands for milk and milk products have grown commensurately. At the same time, intensification to achieve economies of scale has led to a decline in the overall number of dairy farms and an increase in average herd size. Suburbanization has driven land prices up in many of America's rural areas, and owning enough land to dispose of manure in an environmentally responsible manner is becoming more difficult. Further, federal, state and local environmental regulations are requiring many producers to change the way they manage manure. The challenge now facing the U.S. dairy industry is to identify manure management strategies and technologies that will help them comply with environmental regulations and that are cost effective. Likewise, the challenge for agricultural conservation programs is to identify how to best help producers adopt and implement identified best options for his/her region or situation

The National Dairy Environmental Stewardship Council (NDESC) was formed to address both of these challenges. The NDESC's fourteen members are manure management specialists from a variety of backgrounds and represent dairy trade groups, U.S. Department of Agriculture, U.S. Environmental Protection Agency, academic and extension manure management specialists and environmentalists. In addition to identifying a number cost effective manure management strategies (available online at: <http://www.suscon.org/dairies/ndesc.asp>), the Council members also identified key programmatic and policy challenges hindering more widespread adoption of innovative and effective alternatives to manure management and ways to address those implementation challenges.

The objective of this report is to highlight the support needed from agricultural programs to help producers comply with environmental regulations and manage manure responsibly. Because the upcoming 2007 Farm Bill will play a critical role in the implementation of innovative approaches to manure management over the next 5-10 years and beyond, it is crucial that the 2007 Farm Bill provide financial and technical assistance to researchers to continue developing, and to producers to demonstrate and implement, improved and more effective technologies and approaches to resource management on dairy farms as well as the agricultural industry nationwide. In particular, it is essential for the future of innovation and progress in manure management that Congress and the Administration increase funding in the 2007 Farm Bill for programs such as the Environmental Quality Incentives Program (EQIP), Conservation Innovation Grants Program, and Conservation Security Program (CSP) run by USDA's Natural Resources Conservation Service (NRCS); USDA's Agricultural Research Service (ARS); USDA's Cooperative State, Research, Education, and Extension Service (CSREES), US Environmental Protection Agency (USEPA) grant programs dealing with animal agriculture, and other related programs.

Specifically, among the key policy and programmatic recommendations of the NDESC are:

- The selection processes, by which many state and federal programs award incentive and cost share funds (also called “ranking systems”), should encourage the adoption and implementation of innovative approaches. Promising new technologies, tied to achieving desired environmental goals, should reward higher levels of improvement toward defined environmental outcomes. Cost share programs should encourage and fund demonstration projects developed specifically to illustrate defined environmental outcomes and benefits of promising new approaches and technologies.
- To ensure that NRCS funds are used for worthwhile, promising innovations and not wasted on untested or unproven technologies and practices, NRCS should work with key stakeholders in states or groups of states to form Technology Evaluation Teams composed of NRCS, ARS, Cooperative Extension experts, qualified stakeholders and consultants. These Technology Evaluation Teams will selectively evaluate proposed innovative projects and technologies.
- To ensure that the nation’s producers and natural resources benefit to the greatest extent possible from the funds and valuable discoveries of ARS, Congress and the Administration should require that ARS, and Land Grant Universities, NRCS, USEPA, Cooperative Extension, and other relevant agencies develop and maintain a more structured and coordinated means of technology transfer.
- Congress and the Administration should provide funding and direct NRCS to create a more comprehensive and ongoing mechanism to provide training as well as follow-up for operational and maintenance support to technical and field staff. This training should include developments in conservation science, environmental regulations, and effective tools and technologies for meeting conservation goals and operational needs.

Disclaimer

The opinions expressed in this report are those of the members of the NDESC. They should not be interpreted as representing either the policies or opinions of the organizations with whom the members of the NDESC are affiliated. Also, specific trade names and equipment manufacturers or suppliers are mentioned only for information purposes and does not imply any endorsement by the NDESC.

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Implementation Recommendations

Fostering Innovation through Cost-Share Programs

The NDESC believes that the following principles and recommendations are critical to fostering the innovation and ongoing creativity that characterizes US agriculture today. These recommendations offer ideas on ways that programs and organizations can support and enhance development and implementation of innovations in agriculture generally, and are not limited or focused exclusively on the specific technologies and approaches listed in this report.

In addition to encouraging innate creativity, fostering innovation is critical to the success of the nation's dairy industry as it becomes clear that existing practices are not giving producers the tools they need, in many cases, to meet or avoid regulatory burdens. Producers need new tools and technologies that will enable them to cost effectively meet, or even exceed, their own goals and those of society for clean water and clean air. Providing incentives for farmers who want to find ways to manage their dairy operations to be both economically and environmentally sound and sustainable is of fundamental importance.

Equally important is to ensure that agencies, agricultural entities, assistance and research programs help identify and promote best management practices (BMPs) and technologies that will not hurt or can benefit the farmer's bottom line by aiding cow comfort, lowering costs, or increasing milk production. It is those BMPs that are neutral to or enhance a farmer's competitive edge in some manner that will be adopted widely. This fact is fundamental, because of an unwavering reality about dairy farming: The only difference between what a farmer gets for his or her milk and what neighboring farms get for their milk is the difference in the cost of producing that milk or what cost or benefit that BMPs will provide to the sale price. As a result, everything from the price of animals, to the price of feed, to the cost of environmental regulatory compliance goes straight to the bottom line.

In addition to the specific recommendations provided below regarding programs and communications opportunities, we also would like to emphasize the critical role the upcoming 2007 Farm Bill will play in the implementation of innovative approaches to manure management over the next 5-10 years and beyond. It is critical that the 2007 Farm Bill provide financial and technical assistance to researchers, to continue developing, and to producers, to demonstrate and implement improved, more effective technologies and approaches to resource management on dairy farms. In particular, it is essential for the future of innovation and progress in manure management that Congress and the Administration increase funding in the 2007 Farm Bill for programs such as the Environmental Quality Incentives Program (EQIP), Conservation Innovation Grants Program, and Conservation Security Program (CSP) run by USDA's Natural Resources Conservation Service (NRCS); USDA's Agricultural Research Service (ARS); USDA's

Cooperative State, Research, Education, and Extension Service (CSREES); US Environmental Protection Agency (USEPA) grant programs dealing with animal agriculture, and other related programs.

- The selection processes by which many state and federal programs award incentive and cost-share funds (also called “ranking systems”) should encourage the adoption and implementation of **innovative approaches and promising new technologies tied to achieving desired environmental goals.**

Traditional selection processes for most cost-share and incentive programs that offer assistance to dairy and other producers do not encourage or support innovative approaches, but instead focus resources on well-known and widespread tools. While many tried-and-true BMPs and technologies are still important and effective, increasing pressures faced by most dairy producers mean that these traditional tools on their own are not sufficient. Openness to innovation will not only provide producers and their partners with the necessary flexibility to leverage their creativity and hands-on knowledge of agricultural conservation challenges and solutions, but will also help foster creative solutions on one farm that can bring conservation benefits to other farms as well.

- Ranking systems for programs that award federal or state funds should reward **higher levels of improvement toward defined environmental outcomes**, both in terms of the extent of improvement (e.g. percentage improvement in irrigation efficiency or percentage increase in nutrient use efficiency) and the degree of implementation (e.g. more acres, more stream feet, greater volume of animal manure properly managed as determined by a CNMP or NMP).

By focusing on extent and degree of improvement where possible, cost-share programs open themselves to innovative approaches and provide farmers, ranchers, and their partners with the needed flexibility to find solutions that work on their individual farm or in their particular watershed. Where tools to quantify performance are not yet available, NRCS and other agencies should use qualitative measurements or matrices that define levels of performance based on better-known combinations of practices and tools. In addition, NRCS should collaborate with ARS and Land Grant Universities to develop quantitative tools through research to assess performance where such tools do not currently exist.

- Cost-share programs should encourage and fund **demonstration projects** developed specifically to illustrate defined environmental outcomes and benefits of promising new approaches and technologies.

The benefits demonstrated by these approaches and technologies can then be adapted and adopted on other farms, thereby multiplying the benefits of the initial demonstration project across many farms. While up-front construction assistance is important, equally important – and in some cases of greater importance – to the long-term impact of any innovation is financial and technical assistance for ongoing operation and maintenance.

Environmental Quality Incentives Program (EQIP):

One of the most important federal cost-share programs is EQIP, administered by the NRCS. Because of this program's prominence in the funding of environmentally beneficial agricultural practices, and because these funds are limited, several of our recommendations focus specifically on how to ensure that the EQIP program fosters and encourages the development and implementation of innovative approaches that can provide producers with more effective and efficient tools to meet regulatory requirements, avoid the need for regulation, or move beyond regulatory compliance.

- The NRCS should encourage innovation, demonstration, and cooperative projects by providing bonus points for these approaches within the ranking system or by creating a special pool of EQIP funds specifically for innovative, demonstration, and/or cooperative on-site projects.
- To enhance the utility and wider impact of such projects, NRCS should require producers who receive EQIP funds for innovative, demonstration, and/or cooperative projects to conduct or include in their project, through Cooperative Extension or some other entity, comprehensive data collection to monitor the effectiveness of the tool or technology, as well as educational field days.
- To ensure that EQIP funds are not diverted for primary research or wasted on “pixie dust” technologies, producers interested in leveraging EQIP funds for innovative approaches should be required to provide an accepted level of scientific proof regarding the effectiveness of the innovative approach proposed, including sufficient research data and literature review results.
- Producers who receive funding for innovative approaches or technologies should also be required to collect and provide to NRCS and Cooperative Extension detailed data on the performance and impact of the project to allow for effective monitoring and evaluation, for the benefit of the implementing producer and future users of the tool or technology.

Review and Development of EQIP Standards for Innovative Approaches:

- To ensure that NRCS funds are used for worthwhile, promising innovations and not wasted on untested or unproven technologies and practices, NRCS should encourage states and/or groups of states to form Technology Evaluation Teams composed of NRCS, ARS, Cooperative Extension experts, qualified stakeholders and consultants to selectively evaluate proposed innovative projects and technologies.

These State or Regional teams, which could serve as state or multi-state technology subcommittees of State Technical Committees, could evaluate whether the proposed innovative approach has been studied and proven to a sufficient degree to merit EQIP or

other NRCS support. The teams could also review the monitoring data collected by producers implementing innovative approaches and collaborate to develop interim practice standards for worthy tools and technologies. Critical to developing interim standards will be assembling literature regarding the innovative approach or technology into a concise document and identifying appropriate siting, design, and implementation criteria.

Conservation Innovation Grants Program:

Another important federal cost-share program, the newly launched Conservation Innovation Grants (CIG) program, offers much needed resources for implementing innovative approaches and technologies.

- To ensure the program's success, Congress and NRCS should ensure that the budget for this subprogram within EQIP continues to grow in future years and that states are allowed to introduce state-level CIG matching fund programs beginning in 2005.
- To ensure that the knowledge and data from CIG projects reaches a wider audience, NRCS should require CIG recipients to collect and analyze extensive data on the impacts and effectiveness of their project and to develop a rigorous outreach component to the project.
- NRCS should also provide, as part of a CIG project follow-up, technical assistance for the landowner to ensure that the project is integrated into the farm's day-to-day operations. CSREES should be notified of each CIG project and leveraged to implement effective outreach and technical assistance efforts.
- To differentiate between innovation through CIG and innovation through EQIP generally, NRCS should leverage the CIG program to encourage **regional** innovative projects that benefit EQIP eligible producers and the general EQIP program to foster innovation through on-site projects.

Conservation Security Program:

In 2004, NRCS launched the new Conservation Security Program (CSP). With its focus on levels of performance and "rewarding the best, motivating the rest," CSP can and should serve as a powerful engine for effective innovative approaches. To succeed, however, it is imperative that Congress, the Administration, and NRCS continue to expand the program's budget and enable the program to function as the entitlement program intended in the 2002 Farm Bill.

Innovations through Communications and Technology Transfer

Inter-Agency Communication and Technology Transfer:

The Agricultural Research Service (ARS) is an incredibly valuable agency, conducting critical research on innovative tools and technologies to enable producers to better accomplish conservation goals. Unfortunately, too often, ARS discoveries remain closeted within the agency and fail to make the transition to on-farm application through NRCS and USEPA programs.

- To ensure that the nation's producers and natural resources benefit to the greatest extent possible from the funds and valuable discoveries of ARS, Congress and the Administration should require that ARS, Land Grant Universities, NRCS, USEPA, Cooperative Extension, and other relevant agencies develop and maintain a more structured and coordinated means of technology transfer.

One option would be for Congress and the Administration to require the creation of and provide ongoing funding for an inter-agency task force that takes promising and fully tested research from ARS and Land Grant Universities (LGUs), develops appropriate technical standards and educational documents, integrates those new standards into relevant delivery programs, and coordinates dissemination of user-friendly information about developments to NRCS and USEPA technical and field staff (especially those who work with producers directly), cooperative extension staff, producer associations, and other relevant stakeholders. Additional funds and support are also needed for taking laboratory-scale research to the experimental farm-scale research phase and for requirements to collect sufficient data that can be shared not only within that watershed, but also beyond those boundaries with other researchers and demonstration sites around the region or country.

Intra-Agency Communication and Technology Transfer:

Innovative tools and technologies are only useful when they reach the end user – producers.

- Congress and the Administration should provide funding and direct NRCS to create a more comprehensive and ongoing mechanism to provide training as well as follow-up for operational and maintenance support to technical and field staff. This training should include developments in conservation science, environmental regulations, and effective tools and technologies for meeting conservation goals and operational needs.
- Similarly, ARS should require that researchers include in their projects a more rigorous plan for leveraging their research through outreach and education. The assumption should not be that the job of an ARS or Land Grant University researcher is done when the research paper has been published. ARS and Land

Grant University researchers should avail themselves of farm visits on a regular basis to help them understand research needs at the production level.

Role of Producer Organizations in Technology Transfer:

In many cases, the only contact a producer has with the NRCS is through filing of a cost-share program proposal. However, many dairymen regularly read newsletters published by their producer organizations. Also, many producer organizations are actively engaged in helping their constituents meet the challenges of environmental regulations. Articles, written for producer organization newsletters and other dairy publications, about innovative technologies and local demonstration projects are among the most effective ways to communicate information to the dairy community.

- Technology transfer efforts should actively reach out to the variety of dairy publications that dairy producers regularly read to see what's new in the industry, such as: Western Dairy Business, California Dairy, Hoard's Dairyman, Midwest Dairy Business, Northeast Dairy Business, Holstein World, Dairy Herd Management, and Dairy Today.

National Electronic Learning Center for Animal Agricultural Water Quality Issues:

To address the water quality issues associated with animal production, producers and a wide range of stakeholder groups need easy access to current science-based knowledge. Right now, a wealth of science-based information is available. While animal producers and other stakeholders can access individual pieces of this information, the information is widely dispersed among a broad array of websites and organizations. Two highly useful sources of information for animal producers are the national partnerships established by the National Center for Manure and Animal Waste Management and the Livestock and Poultry Environmental Stewardship (LPES) Curriculum, which have created a collaborative environment for educational outreach that crosses organizational and state lines. Building on the success of these models is critical to ongoing technology transfer, especially for highly effective innovations.

One viable option for addressing the need for more centralized, coordinated access to key information has been proposed by an existing national team of experts from Land Grant Universities (LGUs) and stakeholder organizations -- implementation of a model for a national Internet-based information network that provides access to well-researched science-based resources on water quality issues associated with animal production. This proposed project will:

- Implement a web-based National Electronic Learning Center (e-Center), designed and maintained by a nationally recognized team of experts, addressing the priority information needs of customers including livestock and poultry producers, public and private sector advisors, policymakers, educators, and regulatory agency staff.

- Demonstrate and encourage multiple points of access to the e-Center through customer-specific websites maintained by producer associations, regional water quality projects, cooperative extension programs, community watershed groups, and other organizations.
- Field test a national web-delivery model in cooperation with a USDA and LGU initiative to build a national e-Extension system. The project team will utilize a content-management tool designed to enhance the long-term sustainability of the proposed web resources.

The specific project benefits include: (1) real-time and sustainable access to the best science; (2) collaboration among key partners including LGUs, USDA agencies, USEPA, and animal commodity groups; and (3) field testing of an e-Extension model for nationwide delivery of educational resources, potentially benefiting other national educational initiatives.

The proposed National e-Center might need start-up funding from the USDA Cooperative State Research, Education, and Extension Service (CSREES) National Integrated Water Quality Program, the USEPA Collaborative Science and Technology Network for Sustainability program, and the National Agriculture Library's National Digital Library for Agriculture. Once created, Congress should include ongoing operational funding for the National e-Center in the budget of CSREES.

Summary of NDESC Recommended Technologies

Technologies That Help Dairy Producers Match Manure Nutrients To Crop Needs

Feed Management

There are great opportunities to improve the efficiency of nutrients fed to dairy cows, thereby reducing wasted nutrients that end up in the manure. Dairy cows in the US are typically fed 20-25% more phosphorus than is recommended, increasing phosphorous levels in the manure unnecessarily. Ammonia production and loss associated with dairy cows is directly related to nitrogen in cow urine. Reducing nitrogen in urine through diet manipulation can be a first and critical step in reducing ammonia loss from dairy farms.

Through improved feed and forage management, dairy producers can reduce excess phosphorus and nitrogen in dairy cow feed, thereby reducing manure nutrient levels without negatively impacting herd health, reproduction, or milk production. In many cases, improved feed management also provides a cost savings. Feed management is a strategy recommended and useful for all dairy regions and herd sizes.

Synchronized Rate Nutrient Application

Dairy producers in the Central Valley of California – who typically irrigate every 7-10 days in the summer – are protecting groundwater, maintaining crop yields, and saving money using an approach called ‘synchronized rate nutrient application.’ Synchronized rate nutrient application involves determining how much nitrogen the crop needs according to its stage of growth and injecting into the irrigation water just the amount of lagoon liquids that will supply the crop with the amount of nitrogen that the crop will need between the current and next irrigation. The benefits are significant. Producers can reduce or eliminate fertilizer purchases while land applying lagoon liquids in a way that protects groundwater from contamination. This approach is suitable for farms of all sizes that land apply lagoon liquids via irrigation.

Draghose Systems

Producers face a significant challenge in trying to simultaneously reduce phosphorous loss through runoff (via reduced tillage) while trying to reduce nitrogen loss through volatilization (via manure incorporation in the soil). With draghose systems, manure is incorporated in the soil at the same time as it is land applied, thereby eliminating a tillage operation. Immediate incorporation reduces nitrogen losses, improves soil quality, reduces runoff, and significantly limits odor associated with land application of manure. Draghose systems are suitable for any size farm in regions where manure is land applied periodically during the year.

Management Intensive Grazing

In some situations, a shift from confinement or continuous grazing to management intensive grazing can improve farm profitability by reducing input and labor costs, while also decreasing soil erosion, reducing barnyard runoff, reducing soil phosphorus levels, and improving the overall farm nutrient balance. Management intensive grazing (MIG), also known as rotational grazing, decreases costs associated with milk production by moving cows out of confined areas into pastures. With MIG, cows are rotated through multiple paddocks and timing, distribution, livestock type, and stocking rate are managed to achieve optimal pasture forage quality, livestock growth, and protection of water quality. Management intensive grazing is an option in all parts of the country where quality forage is available. This approach is most commonly used on small to medium sized dairies with access to adequate land base for herd size, but some, such as those in Florida, are implementing rotational grazing with herds as large as 1,000-2,000 head.

Land Swapping

Dairy farms that grow their own crops and land apply manure at nitrogen rates over apply phosphorous, leading to high soil P levels. Land swapping is an arrangement where vegetable growers and dairy producers farm each other's land for a period of time, with economic and environmental benefits. Soils previously under vegetable production improve with the addition of dairy manure and forage crop production, and while vegetables thrive on soils with high phosphorous levels and organic matter from years of manure applications (and vegetable growth can also reduce the P levels in those soils). Any size dairy with high soil phosphorous levels that is close to a progressive crop farm can use this manure management technique. Both farm managers need to have long-term plans and be able to stick to them.

Technologies That Assist In Capturing Nutrients In Dairy Manure

Innovative Solid Liquid Separation Systems

Efficient solid-liquid separation systems like weeping walls and double screen separators give dairy producers greater control over manure nutrients. Solid liquid separation is useful for dairies of any size and location. Weep wall systems can remove 60% of the solids in manure and work well in conjunction with sand bedding, as up to 60-70% of the sand can be recovered. Solids from the basin can be recycled as bedding or used as a valuable soil amendment. The double screen solid liquid separator developed by Dias screens manure twice - once for coarse solids, which are recycled as bedding, and the second time on a finer mesh screen to remove fine solids. Reported benefits include significantly reduced odors, cleaner lagoon water, reduced cow injury due to slippage in the barns, and production of a valuable soil amendment.

Anaerobic Digesters

Anaerobic digesters – enclosed vessels that use bacteria to decompose manure (and other organic materials) and produce methane gas – can reduce air pollution, greenhouse gas emissions, pathogens, weeds, and odors from dairy operations while generating valuable energy and heat. In regions where dairies can offset their electricity purchases with

digesters, they are cost effective with potential payback periods of 3 to 6 years, depending on federal cost share fund availability. Anaerobic digesters can be combined effectively with other manure management technologies, including solids separation, and composting to create a comprehensive manure management system. Anaerobic digesters are suitable for any region and are an option for all farm sizes, but economies of scale and energy production favor larger operations.

Wet Manure Collection with Honey Vacs

“Honey vacs” are large, powerful vacuum tankers that can remove manure from dairy alleys or lanes and deliver it to storage, direct land application, or manure processing areas. This eliminates the need for flushing to clean freestall or feed lane floors and provides a cost effective way to transport and deliver manure having a high solids content. Reported benefits include a decrease in flies, odors, and water use, and an increase in herd health and production. Honey vacs can be used on existing open lot and flush dairies and are suitable for any region. Because tanker capacity and collection capability can be scaled according to a dairy’s operational needs, they are also suitable for a variety of herd sizes.

Dairy Manure Composting

Composting transforms raw manure into a biologically stable material that makes an excellent soil amendment. Composting manure reduces the manure solids or raw manure and amendment mixture volume (by 50% or more), reduces odors, pathogens, and weed seeds, and produces a consistent product that can either be land applied on the farm, or sold to ornamental horticulture markets, landscaping companies, homeowners, and neighboring farms. Where acreage is insufficient to land apply manure, composting can be a cost effective method for moving manure off the farm. Composting on-farm can be done year round in most regions of the U.S, even in cold climates and is appropriate on dairy farms of any size. A low moisture/high carbon amendment or solid separation facility will be needed.

Covers for Manure and Wastewater Storage Facilities

Short of anaerobic digestion and aeration technologies, lagoon covers offer the best opportunity for achieving significant reductions (50-90%) in emissions of odor and gases, such as hydrogen sulfide, from manure and wastewater storage facilities. Impermeable covers also reduce accumulation of rainfall in the lagoon, reducing the volume to be handled. The most successful types of lagoon covers are (1) impermeable covers with a vacuum-based gas recovery system, (2) permeable geo-textile covers, and (3) straw covers. This approach is effective for all regions. Similar levels of odor control can be achieved for all sizes of dairy farms, however, economies of scale in the installation and purchase of cover material favors larger farms.

Technologies on the Horizon

Aquatic Cropping Systems

One promising future alternative to land application of manure is to concentrate manure nutrients in algal biomass by cultivating algae in engineered ponds or raceways. Converting the nitrogen and phosphorus in manure into algal biomass increases the value and manageability of the nutrients. Nutrient balance results showed that most of the manure nitrogen and nearly all of the manure phosphorus was taken up by the algae. Use of aquatic cropping systems to concentrate manure nutrients is still in the research phase.

Waste to Energy Technologies

The processes of pyrolysis and gasification can convert biomass into fuels for use in internal combustion engines or turbines. These processes can be used to produce fuel, while reducing the volume of dairy manure and concentrating nutrients. A number of challenges must be resolved before either pyrolysis or gasification is viable for dairy operations, including the high moisture content of dairy manure, variability in manure quality, the need for a consistent and large supply of feedstock manure, the low fuel density and flame temperature of manure compared to coal, and the high capital and operating costs.

BioProcess Technology

BioProcess Technology (BPT) is currently being evaluated as a system for removing nutrients from dairy lagoon water. BPT works by growing microbes that consume organic matter and nitrogen in dairy wastewater on a fixed film. The end product is water with greatly reduced nutrient concentrations and a high nutrient sludge. BPT has been tested successfully on hog farms in North Carolina and is currently being evaluated on a Vermont dairy farm where the Vermont BioReactor receives water that has previously gone through solids separation and anaerobic digestion. This technology is still very much in the evaluation phase for on-farm use, but may prove suitable for dairies that need a high level of lagoon water treatment in the future.

Alternative Herd Management

On average, non-lactating cows that do not need to be confined produce 30-40% of the manure from a dairy operation. Substantial gains in manure nitrogen recycling through crops can be achieved by corralling non-lactating dairy cows and heifers on cropland. A research trial at the U.S. Dairy Forage Center in Wisconsin showed that crop nitrogen uptake in plots where heifers were corralled were higher than where barn manure was applied.

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