Sustainable Livestock & Poultry Production

S-1032 (2007-2013)

Challenges of Assessing Animal Production

Runoff of water from livestock and poultry production facilities can pollute surface and groundwater with excess nutrients, like nitrogen, and pathogens. Airborne emissions, including odors, particulate matter, and bacteria, can also have concerning impacts on the environment and human health. Many tools and practices have been developed to prevent or reduce pollution from livestock and poultry production. While these solutions have been validated in laboratory experiments, pilot projects, and field tests, their overall dynamic impact at the ecological scale is not well understood. In real ecological systems, changes in one element may propagate through the entire system in unpredictable or counterintuitive ways. Without a comprehensive understanding of the overall effectiveness of a technology, a practice, or a policy, industry and government cannot be sure that spending time and money to implement them will pay off.

There are many ways to protect the surrounding environment from pollution from livestock and poultry production facilities, but it can be difficult to assess the overall environmental and economic sustainability of these measures. S-1032 scientists are making sure that livestock and poultry producers have the best practices and technology available to them. Photo by the Socially Responsible Agriculture Project/Flickr, CC License 2.0.

Multistate Research Project Assesses & Advances Animal Production

Since forming, Multistate Research Project S-1032 has fostered in-depth research, innovative design, and thorough testing of technology and practices that are improving the environmental and economic sustainability of livestock and poultry production. Over the last six years, the project has developed new models for each animal industry to better describe each industry's energy flow and ecological footprint. Using these models, the project has been able to develop and evaluate physical, chemical, and biological processes for treating and disposing of or re-using manures and other wastes; housing and feeding systems to manage or modify the excretion and runoff of nutrients; and technology and management practices for reducing and treating airborne emissions. These improvements have made technology easier to use, more efficient, and more affordable, saving producers time and money and making environmentally friendly practices more feasible. For example, improved pig barns save energy and also benefit pig welfare and farm worker health and safety.

Selected Research Highlights

Wastewater

Reduced the cost of sprinkler vegetative treatment systems by 40%, making them more affordable options for managing runoff from small farms.

Made improvements to biofilters, which use living matter to capture and biologically degrade pollutants. For example:

- A new system that combines a biofilter with a water scrubber removed over 90% of particulate matter from poultry facility exhaust air.
- New tools for sizing biofilters lowered costs of biofilters.
- A vertical constructed wetland efficiently removed carbon and nitrogen from milking center wastewater, even during winter when wetland plants grow less.

Manure

New pig barns that store manure in an outside, covered, in-ground concrete tank instead of inside or under the barn, are more sanitary for pigs and farmers and help reduce environmental pollution.

Swine manure pit explosions, fires, and foaming can be prevented by increasing ventilation when the manure is being agitated so that released gases quickly dissipate.

A new system for treating manure flushed from dairy cattle barns achieved removal of 60-65% of total solids, 90-95% of nitrogen, and 70-75% of phosphorus.

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Plants can filter pollutants out of wastewater so the water can be reused. During S-1032 trials, iris plants (shown above), Bermudagrass, and wild millet grew successfully on floating mats in a swine wastewater lagoon. In addition to removing excess nutrients from wastewater, the growing vegetation can be harvested, composted, and used as a soil fertilizer, or transplanted as sod. Photo by Rob Hubbard, USDA-ARS.

Adding gypsum during animal manure composting reduced the amount of nitrogen leaching into the surrounding soil.

Struvite crystallizer turned the phosphorous removed from manure effluent into a product that can be easily dried and handled.

Adding sodium bisulfite to hen manure reduced nitrogen volatilization during short-term storage.

Airborne Emissions

A UV treatment involving a deep UV band and photocatalyst removed up to 100% of odors, gases, volatile compounds, and airborne pathogens. This treatment has an estimated operational cost of $0.15 to $0.59 per pig.

Biowaste to Bioenergy

A hydrothermal process converted manure to crude oil with refined oil yields of 32-42% of the total manure input. Swine manure with higher lipid and protein content yielded more oil.

New, more accurate tests showed that carefully harvested solid manure from open-lot cattle feedyards has a gross energy content that approaches that of lignite coal.

Housing, Feeding & Farming Practices

New pig barns with better insulation, environmental controls, and cooling systems help farmers cut energy use and costs in both winter and summer months. Though building construction costs per pig space are expected to be 1.3 to 2 times higher than typical barn construction, these costs are offset by a 3 to 7% increase in average daily weight gain and 5 to 10% decrease in feed consumption per pound of pork produced.

Doubling the stocking density in cattle feedyards (i.e., reducing the animal spacing by 50%) decreases dust emissions by more than 50% compared to conventional spacing.

Amount of high toxin-producing E. coli in calf manure increased after weaning compared to before weaning.

High Protein Corn Distillers Grain can be substituted for soybean meal in broiler hen diets, but can result in more litter and more nitrogen excreted.

In a Nebraska, one-time deep plowing to invert surface soil with excessively high phosphorous, reduced phosphorous runoff by 51%.

Since 2004, 80% of Michigan pork producers have adopted feeding strategies that reduce their herds' ammonia emissions by 21%, lowering total annual ammonia emissions by an estimated 2,047 tons.

Training

1,000 Illinois livestock producers completed a 3-year, statewide training program that teaches environmental protection, safety, and manure management practices.

Cattle feeders and manure haulers/contractors representing over 2 million head of cattle were trained on how to use manure as fertilizer.

Standards & Regulations

A major Michigan utility is now using information from the Michigan Waste Biomass Inventory to Support Renewable Energy Development to help develop their renewable energy portfolios. This information can also be used to identify the best locations to site technology that converts biowaste to energy. (The inventory determines the amount of biowaste available at a selected site and estimates the net energy available for technologies that convert waste to resources.)

New S-1032 data were used to estimate two critical parameters for the Universal Methane Productivity Equation so it can now be applied to municipal waste digestion.

Regulatory authorities will use data from an S-1032 study to determine whether vegetative treatment systems can be used to control runoff on beef feedlots with National Pollutant Discharge Elimination System permits.

Regulators can use S-1032 data about the transport and fate of hormones given to livestock to set appropriate standards.

S-1032 data were used to update the 1994 National Research Council nutrient requirements for poultry to reflect changes in feeding practices and technological advancements.

A biofilter, shown above, uses living matter to capture and biologically degrade pollutants expelled livestock production buildings. Photo by Rick Stowell, University of Nebraska/Flickr, CC License 2.0.

S-1032 researchers found that decreasing crude protein in turkey diets from 110% to 100% of the amount recommended by the National Research Council reduced nitrogen losses from turkey facilities with no differences in tom growth or feed efficiency. Photo by Scott Bauer, USDA-ARS.

Want to know more?

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- University of Arkansas
- Auburn University
- University of California, Davis
- Colorado State University
- University of Florida
- University of Georgia
- Georgia Cooperative Extension
- University of Hawaii
- University of Idaho
- University of Illinois
- Iowa State University
- University of Kentucky
- Louisiana State University
- Louisiana Cooperative Extension
- University of Maryland
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- University of Wisconsin

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