Manure Management Research in USDA-ARS

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Manure generated at 300,000 animal feeding operations (AFOs) can pose a threat to soil, water, and air quality and to human and animal health. Some of the main problems facing AFOs include: nutrient enrichment of soil and water, emission of odors and greenhouse gases, and control of pathogenic microorganisms. The U.S. Department of Agriculture—Agricultural Research Service (USDA-ARS) uses several approaches to address each area including animal feeding, manure handling, storage and treatment methodologies, land-application protocols, conservation practices, decision-support tools, and alternative uses.

Research is needed to make more efficient use of feed by livestock and poultry and to match feed nutrient concentrations to animal requirements. This approach can reduce volume of manure produced, nutrients excreted, and production costs. Progress has been made in reducing nitrogen and phosphorus concentrations in manure through more efficient use of dietary nutrients.

Losses of nutrients from manure occur during handling and storage and during and after field application. Improved manure handling, storage, and treatment technologies; improved tests for nutrients in manure and soil; tools to identify areas in a watershed susceptible to nutrient losses; improved methods for manure application; and agricultural systems to effectively use and recycle nutrients are needed. Manure amendments have reduced ammonia volatilization and phosphorus solubility. Nutrient recovery from wastewater has been enhanced through improved liquid-solid separation and new treatment technologies. The P Index is being developed to identify and rank the vulnerability of sites to phosphorus loss in runoff. Effectiveness and placement of buffer strips, wetlands, and riparian zones for nutrient and pathogen removal are being evaluated.

Three types of emissions (gases, particulates, and aerosols) affect air-quality changes around livestock operations. Ammonia emissions appear to have the greatest potential for adverse environmental and health impacts, while odorous compounds provoke the greatest public concern. Development of cost-effective methods to reduce and control emissions will require a greater understanding of emissions formation, composition, emission rates, and dispersion. Methods have been developed to measure emission rates from animal-housing and manure-storage facilities. Preliminary results suggest that nitrogen gas rather than ammonia is the primary form of nitrogen released from several lagoons in the Southeast.

Pathogens and parasitic agents in manure can be transmitted to other animals and humans through food supplies and water. Bacteria such as *Escherichia coli, Salmonella, Camplyobacter,* and *Listeria,* and the parasite *Crytosporidium parvum,* have been implicated in human illness. Research will be needed to determine survival, transport and dissemination of manure pathogens in the environment, to assess risks, and to develop appropriate control measures. Initial research has focused on survival of manure pathogens under different conditions and treatments.

Alternative uses for manure are needed in areas where supply exceeds available land and where land application would cause significant environmental risk. Manure use for energy production, composting, pelletizing, or transportation subsidies may be required in areas of oversupply. Alternative production systems that emphasize balancing nutrient inputs and outputs on the farm will need to be evaluated and used where appropriate.

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