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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

Metrics for Nitrate Contamination of Ground Water at CAFO Land Application Sites

Project Type

This is an EPA Region 6 Regional Applied Research Effort project established between EPA's Ground Water and Ecosystem Restoration Division (Elise Striz, Project Officer) and EPA Region 6 (Nancy Dorsey, Project Officer). The research was conducted under Interagency Agreement DW12921711 with the U.S. Department of Agriculture-Agriculture Research Service (USDA-ARS) (David Brauer, Project Officer) and carried out at a dairy site in Arkansas (Philip Moore, Principal Investigator) and a swine site in Iowa (Jerry Hatfield, Principal Investigator).

Project Period

August 9, 2003 through September 30, 2006

Project Summary

Recent research by EPA in Oklahoma has demonstrated that land application of concentrated animal feeding operation (CAFO) waste can cause nitrate contamination of ground water. As a rule, land application of CAFO waste is required to follow a Nutrient Management Plan (NMP). An NMP is a design document that sets rates for waste application to meet the water and nutrient requirements of the selected crops for the soil types present. A tacit assumption is that a well designed and executed NMP ensures that all nutrients are taken up in the root zone so that ground water is inherently protected. This research was carried out by USDA-ARS to assess whether NMPs, when properly executed, are consistently protective of ground water. The study focuses on the identification of soil/crop conditions and land application practices that allow nitrate, ammonia, and phosphate in land-applied CAFO effluent to move beyond the rooting depth of plants, even when applications are made in accordance with a properly designed and executed NMP.

One study was carried out at a dairy site in Arkansas and involved comprehensive sampling of the soils, soil water, and crops for nitrate, ammonia, and phosphate on several plots in the land application area. Over a one-year period, the nutrient values in these samples were compared to the timing and volume of land-application effluent, irrigation, and precipitation



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to discern relationships between land application practices and nutrients entering and escaping the root zone. The data showed high levels of nutrients being transported through the root zone, despite the fact that an approved NMP was being followed. Part of the problem was due to the presence of dairy cows being allowed to loaf in the land application area. Even though this was not disallowed by the NMP, it led to additional application of waste that exceeded the assimilative capacity of the crops. This clearly indicates that changes were needed in the design of the NMPs used for CAFOs in Arkansas.

A second study was conducted for one year (2006) on a swine-row crop farm in central Iowa, using multiple plots with variable manure application and crop schedules. Soil core samples were taken in May and analyzed for soluble components (nitrate, ammonium, soluble reactive phosphorus, pH, and electrical conductivity), as well as exchangeable ammonium and Mehlich III extractable phosphorus. Plant samples were also collected and analyzed for biomass and nitrogen content. The results from this study indicate that application of swine manure effluent at this farm according to the existing NMP should supply nitrogen and phosphorus in sufficient amounts for crop production without leading to a further accumulation of either one in the soil. However, sparse rainfall during the early part of the 2006 growing season resulted in weather that was not typical of central Iowa; this precluded the acquisition of soil pore water from lysimeters.

Products

Hatfield, J.L. (2009). [Metrics for Nitrate Contamination of Ground Water at CAFO Land Application Sites – Iowa Swine Study \(PDF\)](#) (28 pp, 788 KB) (EPA/600/R-09/045) June 2009 - [Abstract](#)

Moore, P.A. and D. Brauer. (2009). [Metrics for Nitrate Contamination of Ground Water at CAFO Land Application Sites – Arkansas Dairy Study \(PDF\)](#) (29 pp, 824 KB) (EPA/600/R-09/044) June 2009 - [Abstract](#)

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