USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Microbial Impacts of Animal Wastes on Water Resources

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Federal Funds: 40,350 Non-Federal Funds: 99,883

Principal Investigator, University:

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Congressional District No: Fourth (NC) and Sixth (KY)

CRITICAL REGIONAL WATER PROBLM

The microbial quality of water resources and the management of the microbially-laden wastes generated by the burgeoning animal agriculture industry are critical local, regional and national problems. Animal wastes from cattle, hogs, sheep, horses, poultry and ether livestock and commercial animals can contain high concentrations of microorganisms that are pathogenic to humans. In particular, the protozoans *Cryptosporidium parvum* and *Giardia lamblia* can be present in cattle (Angus, 1990), hogs (Kim, 1990), horses (Kim, 1990; Poonacha and Turtle, 1989; Coleman, 1989) and other animal wastes. Both organisms have been responsible for many outbreaks of gastrointestinal illness caused by contaminated drinking water (MMWR, 1996). The massive, waterborne Cryptosporidiosis outbreak in Milwaukee, Wisconsin, with more than 400,000 cases, *as* well as the earlier outbreak in the southeastern community of Carrolton, GA. are suspected of being caused by fecal contamination from commercial cattle and possibly other animal operations in the watersheds (Hayes et el., 1988; MacKenzie et el., 1995). Cattle operations also were implicated in an outbreak in England (Lisle and Rose, 1995). Ground waters as well as surface waters can be contaminated by *Cryptosporidium,* as indicated by two ground waterborne outbreaks in the United States (Texas and Pennsylvania) and the detection of the organisms in well water (Lisle and Rose, 1995). Although *Cryptosporidiurn. Giardia* and other human pathogens of animal origin are widespread in both animal and human wastes and in environmental waters, little is known about the relative contributions of agricultural animal wastes to such environmental contamination of water resources (Chauret et el., 1995). This collaborative project between the University of North Carolina at Chapel Hill and the University of Kentucky intends to characterize and quantify the relative contributions of agricultural and commercial animal fecal wastes and human sewage effluents to microbial pathogens levels in surface and ground waters in the two southeastern states of North Carolina and

Kentucky. The project will employ state-of-the-art methodology to characterize, quantify and trace sources of animal and human local contamination in watersheds and aquifers.

Attention is focused on the protozoan parasites *Cryptosporidiurn* and *Giardia.* This is because their locally excreted, environmentally stable forms (oocysts and cysts, respectively,) persist for long periods (months)in water and are very resistant to disinfection by chlorine and other waterand wastewater disinfectants. Both *Giardia* cysts and *Cryptosporidium* oocysts are small enough (about 5-15 micrometers and 3-7 micrometers in diameter, respectively) to pass through granular filtration media, such sand.

EXPECTED RESULTS, BENEFITS, AND INFORMATION

This project will produce definitive information on the occurrence (prevalence and concentrations) of *Cryptosporidiurn, Giardia,* other human pathogens and candidate microbial indicators of these pathogens in raw, treated and stored hog. cattle, horse and possibly other agricultural animal wastes. These data will characterize the extent to which these animal wastes pose a risk to the environment and to human and animal health if the pathogens are not adequately reduced by was treatment processes and practices. This project will provide quantitative data on the rate and extent of reduction of *Cryptosporidium,* other pathogens and their candidate microbial indicators of current and candidate animal waste storage and treatment processes. These data will provide a quantitative basis for determining if stored and/or treated animal wastes pose a risk to human health and the environment when discharged to the environment. This project will quantitative *data* on the extent to which stored and treated animal wastes provide discharged to the environment contaminate nearby surface and ground waters. These data will provide a quantiitative basis to determine the risks to human health and the environment from *Cryptospridium* and ether pathogens of agricultural animal origin in surface and ground waters when used for various beneficial purposes (such as drinking water supplies, primary contact recreation and shellfish raising).

The information (data and data analyses) from this study will provide a scientific basis to perform a quantitative risk assessment of the pathogens from agricultural animal wastes on receiving waters used for various beneficial purposes. At minimum, it provides the essential data needed to assess or judge the risks to public health from microbial pathogens of agricultural animal waste origin in the impacted surface and ground waters. It also provides the necessary information to evaluate or judge the effectiveness of current and candidate agricultural animal waste treatment, storage and disposal practices and overall agricultural waste management practices. If the data on pathogen occurrence in untreated and treated animal wastes and their receiving waters indicate the potential for excessive risks to public health, it provides the scientific basis for pursuing alternative technologies to treat animal agricultural wastes, and alternative practices for waste management and the protection of water resources.

Development of an indicator system to denote the initial source (human or animal), presence, and magnitude of parasitic oocysts in surface waters would serve to protect the

public health by alerting water treatment plant operators and other health officials of increased concentrations while providing information about probable sources upon which to initiate control measures. It is our hypothesis that while a single bacterial, bacteriophage, or biochemical indicator may not show significant correlation with oo/cyst presence and source, a combination of these indicators will. A pattern of indicator presence, or fingerprint, for fecal contamination can be developed that will serve to warn water utilities of increased pathogen loading into their treatment plants and provide them with an identification system to track the patbogen inputs and provide preventive watershed management measures.