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This quarterly's articles:

Leaching Potential of Arsenic and Other Pollutants from Turkey Litter Stockpiled on Bare Soil[1]

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Since arsenic (As) has the potential to cause cancer and other diseases in humans, the EPA has established a maximum contaminant level of 10 ppb for As in drinking water. However, As is fed to turkeys (also broilers and swine) mostly as roxarsone to prevent disease and promote growth. Since roxarsone is largely excreted, microbes in litter and soil can mineralize roxarsone into more toxic and mobile species, such as, inorganic arsenate (As(V)) and arsenite (As(III)) that have oxidation states of 5 and 3, respectively. When litter is removed from the turkey house, it may be land applied immediately or stockpiled to be applied later. When litter is stockpiled on bare ground without cover, warm and moist conditions inside the stockpile combined with rainfall can result in transformation and transport of litter constituents, including As that then leach into the soil. Over time, depending on soil properties and water table depth, As from turkey litter could contaminate the ground water. Turkey litter also contains many other constituents such as nitrate-nitrogen (NO_3^--N), ammonium-N (NH_4^+-N), phosphorus (P), and heavy metals that can cause water quality problems if they contaminate ground or surface waters.

While researchers have evaluated the mobility of litter constituents in land-applied litter, no literature on mobility of As and other constituents from stockpiled poultry litter is available. Stockpiling poultry litter, uncovered on bare soil, is common practice in North Carolina and other states. This study was used to evaluate (1) transformation of As and other turkey litter constituent species in uncovered litter stockpiles established on bare soil and (2) movement of these potential groundwater contaminants into the soil beneath the stockpiles. The study was conducted in Clinton, NC, during May 2004 to April 2005. Four turkey litter stockpiles (4.5 tons ea.) were established on Orangeburg loamy sand soil for 161 days (summer stockpiles). The stockpiles were about 15 ft in diameter. Two stockpiles were instrumented for measuring temperature and moisture content. Turkey litter samples were collected prior to and at the end of stockpiling. Soil samples were collected down to 24-in. depth beneath stockpiles (center, half diameter, and diameter) and beyond the stockpile footprints. After removing the summer stockpiles and leaving the site bare for 13 days, four winter stockpiles (November 2004 to April 2005) were established for 162 days over the same footprints. The winter stockpiles were treated the same as the summer stockpiles but were not instrumented. The turkey litter samples and soil samples were analyzed for pH, electrical conductivity (EC), total carbon (C), dissolved organic C (DOC), total N, NH_4^+-N, NO_3^--N, total P, dissolved P, total As, dissolved As, total copper (Cu), total zinc (Zn), and total manganese (Mn). Some important conclusions are summarized below.

- High temperature (>36°F higher than ambient temperature) and moist conditions in the stockpiles during summer stockpiling provided favorable conditions for biochemical activity in the stockpiles.
- During summer stockpiling, pH and concentrations of dissolved constituents (except NO_3^--N) were higher in the core due to leaching from the skin (top 6-in.) into the core (6 to 36 in. inside the stockpile). However, during winter stockpiling, concentrations of all water soluble constituents decreased in the core as well, possibly due to leaching into the soil below.
- Reduced dissolved As concentrations in both the skin and core in the winter stockpiles indicated that dissolved As leached into the soil below.
- Arsenic was found mainly as As(V) in the litter at the end of stockpiling (both summer and winter).
- Soil beneath the stockpile stayed warmer and wetter than the soil outside the stockpile footprints indicating that constituents leached into the soil from the stockpiles would have more favorable conditions for biochemical transformations and movement.
- In the soil beneath the stockpiles, generally, the highest concentrations of most litter constituents in the soil were at the half diameter followed by the center. Greatest increases in pH were observed at the center and greatest NO_3^--N leaching occurred at the diameter location.
- Highly mobile constituents (e.g., NO_3^--N) and pH impacted the soil beneath the stockpiles down to at least a depth of 24 in. For example, NH_4^+-N concentrations in the 12-24 in. soil depth were as high as 740 ppm at the end of the study compared with less than 1 ppm before stockpiling.
- Less mobile species (e.g., dissolved P) impacted mainly the top 12-in. depth though there was some leaching into the 12-24 in. depth. At the end of the study, dissolved P concentration in the 12-24 in. soil depth was as high as 17 ppm compared with 0.01 ppm prior to stockpiling.
- In the soil, As was present mainly as As(V) as was in the case in the turkey litter after stockpiling.
- Total soil As concentrations beneath stockpiles were always less than 5 ppm, comparable to background soil As concentrations in the 12-24 in. depth. However, stockpiling resulted in elevated dissolved As concentrations throughout the sampling depth even though no dissolved As had been detected prior to stockpiling. For example, at the end of the study, dissolved As concentration in the 12-24 in. soil depth was as high as 150 ppb and much higher in the soil layers above it.
- There was evidence of Cu leaching down into the soil profile from the stockpiles. Copper concentrations in the 12-24 in. soil depth doubled to 10 ppm during stockpiling.
- High dissolved P concentrations in the litter and the underlying soil can increase arsenate leaching by displacing arsenate from cation exchange sites (on the soil particle surface). Arsenic leaching would be of greater concern in poultry litter containing higher As concentrations. Total As concentrations reported in the literature are as high as 77 ppm while the highest concentration in this study was less than 16 ppm.

This study indicated that there was potential for As and other turkey litter constituents to contaminate ground water. The following actions are recommended to protect groundwater quality and safeguard public health.

1. Poultry producers should be persuaded not to stockpile litter in the open on bare ground. Ideally, litter should be stored in a covered shed with a concrete floor; however, a less expensive solution would be to store the litter on a tarpaulin (or other impervious material) and cover it with a tarpaulin as well. A proper storage system will reduce the potential for groundwater contamination as well as runoff and volatilization losses of litter constituents.
2. There is need to evaluate movement of litter pollutants through the soil on poultry farms where litter had been or was stockpiled on bare ground by monitoring soil, groundwater and well water concentrations. Monitoring of farms should be prioritized based on arsenic content in feed or litter, duration of stockpiling on bare soil, soil texture, water table depth, and drinking water source (humans or animals).
3. Some states such as Georgia and South Carolina have litter stockpiling regulations; e.g., in SC, litter cannot be stockpiled uncovered for more than 3 days. However, there are other poultry producing states that do not have regulations on litter stockpiling. There is need for science-based regulations to ensure that poultry litter storage does not adversely impact water quality.

EPA Proposes Revisions to CAFO NPDES Rules

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The Environmental Protection Agency has proposed revisions to the CAFO National Pollution Discharge Elimination System (NPDES) rules in response to the order issued by the Second Circuit Court of Appeals in *Waterkeeper Alliance et al. v. EPA* (2005). There are several aspects of EPA's current CAFO regulations this proposal would revise and clarify. EPA is soliciting comment on the proposal and its implementation methods. Although this article will attempt to summarize the major revisions, the entire proposal and supporting documents can be viewed on EPA's website: http://cfpub.epa.gov/npdes/afo/aforule.cfm.

Duty to Apply: The current regulations assume that all CAFOs with a certain number of animals have the potential to discharge, and therefore, have a duty to apply for permit coverage. The court ruling vacated this 'duty to apply' and stated that only those operations that actually discharge must seek permit coverage. In this proposal, EPA would only require those CAFOs that "discharge, or propose to discharge" to seek coverage under an individual NPDES or general permit. For those operations that do not discharge, no federal permit is needed.

Public Participation of Permits: EPA proposes to require all CAFOs seeking permit coverage to submit their nutrient management plan (NMP) with their application for an individual permit or their notice of intent for a general permit. The permitting authority must review the NMPs, and the NMPs must be provided to the public for review and comment on ***<u>all</u>*** CAFOs seeking individual or general permit coverage. Terms of the NMP will be incorporated into the permit as enforceable conditions of the permit. The EPA is soliciting comments on various methods to provide adequate and meaningful public participation and incorporation of the NMP into the permit. For details, please refer to the proposal.

Zero Discharge Requirements: EPA proposes to remove the 100-year-24-hour containment structure standard for new large swine, poultry and veal operations and replace it with a no discharge requirement.

In addition to these revisions, EPA provides clarification on Water Quality Based Effluent Limitations (WQBELs) on production area discharges and its selection of Best Conventional Pollutant Control Technology (BCTs) for pathogens. All other aspects of the NPDES requirements and ELGs of the 2003 CAFO rule remain unchanged other than the extension of the deadline (provided in a separate rulemaking) to July 31, 2007.

The proposed rule was published in the Federal Register on June 30, 2006 which marked the beginning of the 45-day comment period. <u>It may be noted that the EPA extended the comment period from August 14 to August 29, 2006</u>. EPA scheduled public meetings on the proposed revisions in Washington, DC (July 12), Fayetteville, NC (July 24), Ames, IA (July 25), Golden, CO (August 1), Dallas, TX (August 2), and Sacramento, CA (August 3). A webcast was held on August 8, 2006.

Environmental Issues Affecting Small Farmers Raising Hogs on Pasture

Edmund R. Buckner, La'Tonya Richardson, and Robert Felsmanm from Univ. of Arkansas at Pine Bluff; Mike Daniels from the Univ. of Arkansas, Fayetteville; and Sam Dennis from Tennessee State University

Today, hog farming can be divided into two different production systems. The predominant production system is an animal feeding operation (AFO) where animals are confined for at least 45 days during any 12-month period. A concentrated animal feeding operation (CAFO) is an AFO which has at least 2,500 hogs that weigh at least 55 pounds. An AFO with at least 750 hogs can be called a CAFO if it discharges pollutants into navigable waters either through a man-made ditch, flushing system, or other similar man-made device, or directly into waters of the United States. The second production system is one where less than 750 hogs (but mostly a couple of hundred) are raised. This article examines regulatory issues that such small farmers who raise hogs on pasture (Figure 1, next page) may encounter. These issues include avoidance of public nuisance problems, surface water pollution, and space requirements.

Figure 1. Pigs raised on pasture. There should be at least 50% groundcover to prevent environmental degradation.

New U.S. Environmental Protection Agency (EPA) rules that took effect on April 14, 2003 require CAFOs to obtain National Pollutant Discharge Elimination System (NPDES) permits from the EPA or a designated state permitting authority. Smaller hog operations (less than 750 hogs) typically do not require an NPDES permit. However, proper vegetation should be maintained for pasture raised hogs. Vegetation must be trimmed to allow air to circulate, and 50% percent groundcover must be maintained on pasture where hogs are raised. A pasture management plan is highly recommended to ensure that vegetation is maintained. A simple nutrient management plan should be developed to dispose of waste in an environmentally friendly manner. The local Extension Service and NRCS can assist a farmer with pasture management plans.

Hog waste management options: A farmer with pasture raised hogs may use the following methods to manage waste:

1. Solid waste handling, or scrape and haul, is used on many dairy farms and in some beef and hog operations. This method involves scraping and collecting solid or semi-solid waste for land application. Waste is hauled and spread on cropland daily or stored temporarily until land applied. There is usually no processing or treatment of waste, and a conventional box spreader is commonly used to spread the material. Some facilities scrape their shading areas and stockpile their waste.
2. Composting solid waste is a biological process that involves the aerobic decomposition of organic matter to produce a humus-like product called compost. During the composting process, heat, various gases and water vapor are released, greatly reducing the volume (by up to 50%) and mass of the pile. Dead hogs may also be fully composted. Composting also destroys weed seeds and pathogens, provides a stable organic nutrient reservoir and a final product that is odorless and potentially, marketable.

Nuisance Issues: A public nuisance may include, creating a breeding ground for flies, mosquitoes and rodents, along with sewage, due to how waste and/or food is handled. Creating, permitting, maintaining or continuing any public nuisance is prohibited. Care must be taken to ensure small hog operations avoid the above mentioned nuisances.

Odors can be a nuisance, but not necessarily one that is regulated at the federal level; however, many states and counties now have odor regulations. Most importantly, farmers are urged to consider neighbors. Even if there may be no laws regulating odor, but there may be laws that regulate air quality. All local and county health department and federal laws must be followed.

Proximity to Neighbors: Local ordinances on keeping hogs should be followed. Again, it is important for the farmer to communicate with his/her neighbors.

Prevent Water Pollution: No matter the size, or classification of hog production system, waters of the United States can not be polluted. No sewage, food, garbage, drainage from swine is to be discharged or disposed of by means or manner that jeopardizes ground water quality, or waters of the United States. Each state's agency of environmental quality should be consulted on setbacks for hog operations wells or waters of the United States. A permit may have to be obtained if there is a chance for pollution of United States waters.

Management Measure for Small Swine Farm Operations: Small swine farms should be managed to minimize impacts on water quality and public health. To meet this goal the following should be addressed:

1. Divert clean water (run-on from uplands, water from roofs) to prevent from contact with swine

pastures and holding pens, animal manure, or manure storage systems.
2. Prevent seepage from buildings, collection systems, conveyance systems, and storage facilities through proper design and maintenance.
3. Develop a nutrient management plan.
4. Dead animals should be managed in a way that does not adversely affect ground or surface waters.
5. Consider the full range of environmental constraints and requirements. When starting a new or expanding an existing swine operation, consideration should be given to the proximity of the facility to (a) surface waters; (b) areas of high leaching potential; (c) areas of shallow groundwater; and (d) sink holes or other sensitive areas. Additional factors to consider include minimizing off-site odor drift and the land base available for utilization of animal manure in accordance with the nutrient management measure.

Utilize a riparian buffer between swine pasture and receiving streams. A riparian buffer is simply a strip of trees and other vegetation growing along the banks of a stream. Riparian buffers prevent most of the nitrate nitrogen in ground water from reaching surface waters. The plants that form a riparian buffer take up, or consume, some of the nitrogen. Most of the nitrogen, however, is denitrified by bacteria that live in the wet soil near a stream and feed on the dead roots of vegetation. These bacteria turn nitrate nitrogen into gases that escape it into the atmosphere.

Space Requirements for Hogs: The amount of space needed per pig for optimal performance is an important planning-management consideration for modern production systems (Table 1). Overcrowding may result in tail biting or cannibalism, reduced weight gain, increased feed required/unit gain, gastric ulcers, and/or additive stress factors may cause increased susceptibility to disease or other adverse effects on performance or reproduction.

Producers should provide 400 to 800 or more sq. ft. per pig for pasture. Note that conditions of the pasture and the shade space are as important as the area provided. Good judgment and the ability to adjust to changing conditions is good management. Appropriate slopes are necessary for swine production. Slopes less than 2% are most often considered insufficient, while slopes over 5% may be excessive. Remember to maintain at least 50% vegetated ground cover on hog lots.

Table 1. Pasture and Dirt (Soil) Lots

Pasture space (depends upon rainfall, soil fertility, and plant growth)	Shade space
10 gestating sows/acre	15-20 sq. ft./sow
7 sows with litters/acre	20-30 sq. ft./sow and litter
50 to 100 growing-finishing pigs/acre	4 sq. ft./pig to 100 lb. 6 sq. ft./pig over 100 lb.

For More Information:

- Visit Southern Regional Water Program, Nutrient Management Planning
- To obtain Pork Industry Handbook, and space requirements for swine: http://www.ces.purdue.edu/porkindustryhandbook2/
- For help developing waste and pasture management plans, contact the NRCS Natural Resource Conservation Service, Cooperative Extension Service, or the University of Arkansas at Pine Bluff. Contact information is at www.ar.nrcs.usda.gov or www.uaex.edu

Animal Waste Management Program

The Animal Waste Management Program is one of 12 priority program areas identified by the Southern Region Water Program Planning Committee. The multi-disciplinary regional workgroup of animal waste management experts is improving animal waste management recommendations to enhance both economic and environmental outcomes in threatened and impaired watersheds. Through strengthened regional and multi-agency collaboration, the workgroup identifies gaps in knowledge and resources, defines significant research needs, and conducts strategic planning to develop appropriate educational and technology transfer tools. Questions or comments may be directed to the team leaders or the appropriate state contact.

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Upcoming Events and Announcements

National - International

- September 27-29: Waste Management Problems in Agro-Industries, Amsterdam, The Netherlands (http://www.moorga.com/Agro%20Industries/Conference4.htm)

Statewide – Regional

- October 10-12: Compost Facility Operator Training Workshop, Athens, GA (http://www.ugaed.com/)
- October 23-25: National Poultry Waste Management Symposium, Springdale, AR (http://www.ansci.umn.edu/poultry/events/2006%20NPWMS%20final%20program.pdf)
- North Carolina: Multiple trainings on waste and nutrient managements are offered in NC. Some trainings (September to November) are listed below.
    1. September 19: Waste system inspection review, lagoon monitoring and maintenance, Waste and Soil Sampling and Interpretation, Calibration of Hard-Hose Travelers, Raleigh, NC (http://www.soil.ncsu.edu/swetc/animal/animalwaste.htm)
    2. September 27: Animal waste management training including compliance activities relating to sludge evaluation, equipment calibration, site management, and soil and waste sampling will be discussed. The field day location is to be determined. Contact Nancy Keith at (336-679-2061) for information.
    3. November 7-8: Writing a Certified Nutrient Management Plan (RUSLE/PLAT), Raleigh, NC (http://www.soil.ncsu.edu/swetc/plat/plat1htm.htm)

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