CONSERVATION INNOVATION GRANTS
FINAL Progress Report

Grantee Name: Maryland Department of Agriculture	
Project Title: **Demonstration of Alternative Containment Structures for Poultry Litter Stockpiling**	
Project Director: Louise Lawrence, Maryland Department of Agriculture	
Contact Information: Louise Lawrence	Phone Number: 410/841-5973 E-Mail: LAWRENL@MDA.STATE.MD.US
Period Covered by Report: 10/1/06-9/30/09	
Project End Date: 9/30/2009	

Project summary:

The project was a demonstration and comparison of alternative containment structures to accommodate whole house clean outs of poultry houses which occur once every 2-3 years. (Current poultry waste structures are designed to accommodate only “crust outs” between flocks.) Project evaluated and compared environmental benefits to water quality and cost effectiveness and systems management changes of three types of structures in the mid and lower geographic regions of Maryland’s Eastern Shore.

Project was to work with six (6) producers and provide technical and financial assistance to implement and monitor containment structures to stockpile poultry litter from poultry production grow out facilities when cleanouts occur during times of the year when nutrients in the poultry litter cannot be used for crop production.

The potential outcome of this project was to verify or modify standards and specifications as suitable for stockpiling containment structures and justify their eligibility for state (MACS) and federal (EQIP) cost share.

Project work performed:

The pads were installed up and down the Maryland portion of the Delmarva Peninsula. Potential cooperators were identified by the Soil Conservation District and they made the initial contacts. Pads were located where cooperators agreed to work with us rather than where a location was desired. Pads were designed by the NRCS so they would qualify for EQIP funds. The Soil Conservation District let the contracts for construction and supervised the pad construction. The SCD was an essential component of this project. Installation of the pads was done between July 2007 and March 2008.

The process for a single pad was to determine a location, mark it with flags so that the construction crew knew where to put the pad and then install the two suction lysimeters that went beneath the pads. We then waited until the construction contractor installed the pad, at which point, the two suction lysimeters were installed at the edge of the pads.

Each suction lysimeter was approximately 36 inches below the soil surface. The tubes were run in trenches beneath the soil surface to a 4X4 post located near the pads. The lines were run in a hand-dug trench at first. Experience taught us that the hand-dug trench was not deep enough and trenches were cut 12 inches deep with a mechanical trencher.

Controls (no pads) were installed between 11-14-08 and 11-26-08. The control sites were set up slightly differently that the pad sites. There were two lysimeters located at the edges of the pile and there were two lysimeters located approximately 10 feet into the pile, just as the pad sites were set up. Additionally, there was one lysimeter located off the agricultural field so that it was away from both the litter and any agricultural operations.

Sampling was a two-step operation in which suction was applied to the lysimeters, time was allowed for the lysimeter to pull soil water in, and then the sample was collected. A minimum of three days passed between applying suction and collecting samples. When samples were collected ,the entire volume was removed, but only 250 mL were retained for chemical analysis. There were five litter stockpiles on various pads and two stockpiles that were not on pads. Approximately 300 water samples were collected between10/25/07 and 9/15/09.

Table 1 provides information on the locations and the soils that received the experimental pads. The soils varied greatly from the fairly permeable Sassafras to the clay-like Othello.

Table 1Pad locations, soils and some selected *soil characteristics.

Pad	County	Soil	Slope	Depth to High Water Table	Permeability (iph)
Cement	Somerset	Galestown loamy sand	0-2%	0-4’	0.63-2.0
Soil Cement	Dorchester	Hammonton Sandy Loam	0-2%	2’’	2.0-6.3
Clay 1	Caroline	Sassafras sandy loam	0-2%	>5’	2.0-6.3
Clay 2	Somerset	Othello silt loam	0-2%	0-2’	0.23-0.63
Control	Dorchester	Downer sandy loam	0-2%	3’	2.0-6.3
Control	Dorchester	Downer sandy loam	2-5%	3’	2.0-6.3

*Soil characteristics reported in soil surveys of respective counties.

Table 2. Construction costs for 40X60 foot pads.

Material	Cost
Concrete 1	$ 11,240.00
Concrete 2	$ 15,692.00
Clay 1	$ 10,500.00
Clay 2	DIY
Soil Cement	$ 7,000.00

Project Outcomes:

Project limitations precluded replicates sufficient to statistically prove anything. Results do suggest some things, but they must be tested more rigorously prior to making absolute statements about the value or acceptance of pads.

Farmers readily accept and value cement pads. Soil cement pads are also acceptable but contractors will need some education to develop sufficient skills if soil cement pads are to become widely used. The average cost for concrete was $13,466, $10500 for clay, and between $7000 and $8300 for soil cement. It was a surprise that clay was so expensive.

There are no recommendations for altering current NRCS specifications for these pads.

Pads improved the restriction of nitrate movement at the edge of a pad piled with poultry litter, but don't eliminate nitrate loss to soil water. There were two clay pads and they each had different behavior. The clay pad built by a contractor (Clay 1) had high nitrate values after approximately 40 days. The farmer-constructed clay pad (Clay 2) had almost no nitrate at any time or location. Clay 1 was constructed on a Sassafras sandy loam, while Clay 2 was constructed on an Othello silt loam. The Othello soil was low (even for Othello soils) in the landscape. Water often stood near the pad (but not on the pad). This suggests that the pad may have been near saturation and the soil may have been anaerobic much of the year. Under anaerobic conditions, ammonia does not readily convert to nitrite and then to nitrate. As a result, little or no nitrate would be available for transport. Therefore, the Clay 2 pad results in low nitrate, but it may have nothing to do with the pad and everything to do with the soil.

The concrete pad experienced a rapid rise in nitrate concentration both in the center and at the edge. This peaked at approximately 200 days. There was a second rise at approximately 575 days (one year later). Both peaks coincide with mid-March. Because both center and edge tracked each other so exactly, there is a suspicion that hydrology and climate may be the driving factor, at this site. During the winter, this site has standing water that up-wells from the ground water. During the summer, core samples taken through the first 36 inches were extremely dry. Again, this suggests that the pad may have been near saturation in the winter and the soil may have been anaerobic for a period of time. Under anaerobic conditions, ammonia does not readily convert to nitrite and to nitrate and this would be consistent with nitrate concentrations dropping from 130 mg/L to less than 20 mg/L over a 150 day period (figure 14). The peak nitrate concentrations beneath the soil cement occurred in early March through early April. The highest nitrate concentrations beneath the Clay 1 at the edge occurred in early April through early May.

The difference between the average nitrate concentration at the center and the average concentration at the edge was plotted to look at changes due to the pad. It was expected that the nitrogen concentration at the pad edge would be higher than at the center because the pad was expected to act as a barrier and afford some degree of protection from the nitrogen in the litter. If that were the case then the plot should always have values less than zero. However, this was not substantiated by monitoring results. The soil cement and concrete pads both had positive values for much of the experimental period.

Overall, NH_3-N was not a great concern, but there were elevated NH_3-N values at the edge of two pads. The reason may be decomposition of litter that washed off the pads.

Background soil water nitrate values (before litter piles were built) were as high as 33 mg NO_3-N/L. Without pads, nitrate did not increase above 20 mg/L for the first 75 to 120 days. Then nitrate increased very rapidly to very high levels, even after the litter was removed. It is tempting to say that short term storage (0-75 days) does not release significant nitrate, but that optimism must be tempered with the observation that nitrate increased after the pile was removed and might exhibit the same exponential increase if piles were removed earlier than the 120-180 days of storage in this project. Data was not collected for litter stockpiled on pads for 14-75 days, so increases in nitrate beneath the piles after the piles are removed cannot be determined.

Outstanding Questions:

Without pads, nitrate increases over time, even after the litter is removed. EPA NPDES permits allow no more than 14 days for in-field stockpiling . Research suggests that 30-60 days pass before the nitrate level in lysimeters begins to increase. What sort of nitrate increase develops after 14-45 days of stockpiling as compared to the increases observed after 180 days of litter stockpiling?

Soil type has been identified as a major factor in nutrient loss from stockpiles. Soil properties have been an uncontrolled variable in this work and many other projects. What effect would pads have if the soil parameters were more controlled? (It is not very practical to attempt to completely control soil factors as they vary very locally). Would pads have a more pronounced effect on concentration?

Mass transport of nutrients from stockpiles has not been rigorously measured in sub-surface flow, yet that is the mechanism for nitrate to get to the groundwater. Other than the estimates made in Binford and Malone (2008) there is very little knowledge concerning how much nitrogen a stockpile contributes to the groundwater in comparison to other accepted farming practices. It is possible that regulations and management practices are targeted to a practice (field stockpiling) that offends the eyes but has no major impact on nutrients.

NH_3-N concentrations are extremely low beneath the control plots. Why are the concentrations so high at the edge of the cement and one clay pad? What mechanism is causing elevated NH_3-N and what practice might ameliorate this?

Well-stacked stockpiles developed crusts. Typically, we want to stack the litter as well as possible to encourage shedding water. Field observations indicate that the litter beneath the crust is in essentially the same condition as when the pile was built: specifically, fairly dry. Is this the best approach for a stockpile? If a stockpile absorbs all or most of the precipitation and does not reach saturation, we then have wet litter, but it has not generated runoff or leaching water. Would it be better to allow the litter to absorb the precipitation and keep that precipitation from becoming runoff or leaching. The current practice is to build the pile to shed water, but that water is going to slow down or stop if it runs off the side of the pile to the bottom edge of the pile. Will the very wet conditions at the bottom edge of the pile foster more leaching than if the entire pile was shaped to collect water?