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Performance of Conservation Practices Implemented at Northwest Arkansas Poultry Operations

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Introduction

In northwest Arkansas, poultry production has long been a driving force of the area's economy and remains a significant contributor to Arkansas agriculture (University of Arkansas System Division of Agriculture [UADA], 2023). While the generation of broiler chickens (*Gallus gallus domesticus*) has seen significant improvements and innovations to production, as well as nutrient management of land-applied poultry litter to pasturelands (Huang et al., 2016; Ashworth et al., 2021), less is known about nutrients originating close to poultry houses. Concerns persist regarding how to manage nutrient runoff from poultry houses in an environmentally sound and sustainable manner.

Remedial efforts to reduce phosphorus (P) and nitrogen (N) runoff from poultry operations include, but are not limited to, grassed waterways, retention ponds, vegetative buffer strips, and alterations to poultry house construction (United States Department of Agriculture-Natural Resources Conservation Service [USDA-NRCS], 2021). As a result, two northwest Arkansas producers affiliated with the poultry industry and are part of the Arkansas Discovery Farms Program (ADFP) have each established conservation practices (CP) to mitigate P and N runoff from their respective farms.

Grassed Waterways - USDA-NRCS CP 412

The Jeff Marley farm is in eastern Washington County near Elkins, Arkansas, and has been active in poultry production and beef (*Bos taurus*) grazing for approximately 40 years. The farm is in the Beaver Lake – Upper White River watershed and has 12 poultry houses and contains 1,200 acres (ac) of pasture and around 1,000 ac of forest. The Marley farm has been recognized by local and national organizations as a consistent and profitable poultry operation, as well as being lauded as promoting environmental stewardship through the farm's association with ADFP.

Research at the Marley farm from 2013 to 2019 investigated migration of nutrients and sediment originating from close to the poultry houses to an ephemeral stream that flows into the White River. A pasture historically used

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Visit our website at: http://www.uaex.uada.edu for grazing was converted to a hay field to simulate a grassed waterway, or USDA-NRCS CP 412 (Figure 1). The rationale behind the use of grassed waterways is based on the potential of grass species, such as Bermudagrass (*Cynodon dactylon* L.) and Johnsongrass (*Sorghum halepense* L.), to impede, retain, and promote plant uptake of runoff-transported nutrients flowing from the poultry houses.

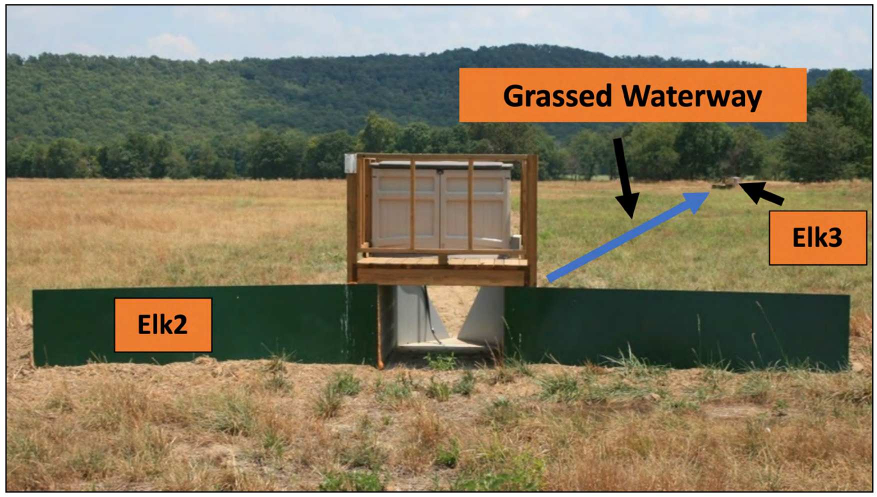

Figure 1. Photograph of the grassed waterway (CP 412) at the Jeff Marley farm in Elkins, AR. Photograph courtesy of Arkansas Discovery Farms. Blue arrow indicates direction of water flow.

Statistically analyzed mass losses (i.e., loads) of nitrate-nitrogen (NO_3-N), total nitrogen (TN), dissolved phosphorus (DP), and total phosphorus (TP) for the grassed waterway from 2013 to 2019 are displayed in Figure 2 and reported in units of pounds per acre (lb./ac). There are two ADFP sampling stations associated with the grassed waterway: ELK2, which is close to several poultry houses and is located at the entrance to the field, and ELK3, which is stationed at the downslope end of the waterway and is directly adjacent to the ephemeral stream. The grassed waterway has shown to be significantly effective in reducing NO_3-N and TN transport across the field, while DP and TP loads were statistically similar between the beginning and end of the grassed waterway. These results corroborate the absolute nutrient reduction potential rating of medium for this CP as determined by extensive monitoring data at the Marley farm (Sharpley et al., unpublished data).

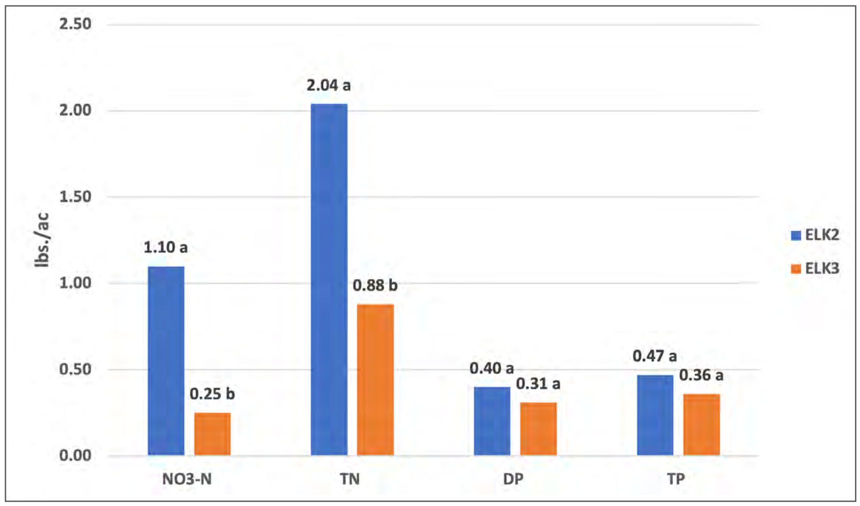

Figure 2. Average Elkins mass losses of nitrate-nitrogen (NO_3-N), total nitrogen (TN), dissolved phosphorus (DP), and total phosphorus (TP) in pounds per acre (lbs./ac) for the beginning (ELK2) and end (ELK3) of the grassed waterway at the Marley farm. Data collected and statistically analyzed from 2013 to 2019. Bars with different letters within an analyte are significantly different at $P \leq 0.05$.

The cost of implementing this CP is low, especially if a grassed area already exists on a particular farm. According to the USDA-NRCS, the unit cost share for implementing this CP is approximately $200/ac. Landowners can receive financial assistance from NRCS for CP 412 based on qualification through the Environmental Quality Incentive Program (EQIP) or other NRCS programs. Contact your local USDA Service Center for more details and information.

Retention Pond – USDA-NRCS CP 378

Nutrient and sediment retention pond (USDA-NRCS CP 378) is another CP that was evaluated for field performance. During construction of the poultry houses, a pond was excavated, and the removed material was used to build raised, earthen pads as the foundation for the production houses. Earthen berms were constructed to direct runoff from around the houses to the existing pond to simulate CP 378. The logic behind retention ponds is to limit the movement of nutrients and sediment from poultry houses to other areas of the farm along with providing an on-farm water resource (Figure 3).

Retention ponds are often constructed according to a farm's acreage and topography.

Figure 3. Photograph of the retention pond (CP 378) at the Jeff Marley farm in Elkins, AR. Photograph courtesy of Arkansas Discovery Farms.

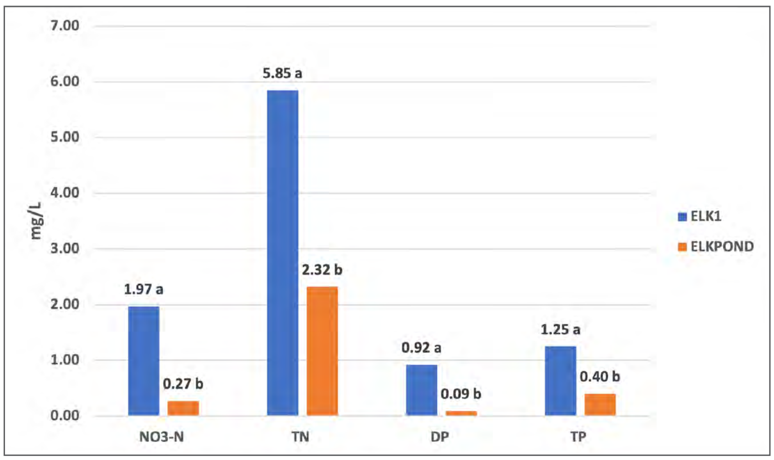

Figure 4. Average Elkins nutrient concentrations of nitrate-nitrogen (NO_3-N), total nitrogen (TN), dissolved phosphorus (DP), and total phosphorus (TP) in milligrams per liter (mg/L) for the entrance to the retention pond (ELK1) and the exit (ELKPOND) at the Marley farm. Data collected and statistically analyzed from 2013 to 2023. Bars for an analyte with different letters are significantly different at $P \leq 0.05$.

Retention ponds differ from liquid animal waste lagoons, as retention ponds only collect stormwater runoff and do not collect manure transported by rinse water from a production facility, such as a milking parlor associated with a dairy. Retention ponds are designed to accommodate runoff as well as precipitation. If properly designed and maintained, a retention pond functions much like a stock pond and can provide several benefits, such as a water source for livestock, aquatic habitat for game fish and other wildlife, and provide many recreational uses.

The cost of applying this CP can vary from low, if a pond already exists on a farm and runoff can be routed to the water body, to high, due to dredging and other related services. However, financial assistance is available from NRCS based on program qualification. The USDA-NRCS unit cost share for retention pond installation is \$0.43 per cubic yard (yd^3).

Statistically analyzed NO_3-N, TN, DP, and TP concentrations collected from 2013 to 2023 at ADFP sampling stations located at the entrance to the retention pond (ELK1) and the pond's outflow (ELKPOND) are displayed in Figure 4 and reported in units of milligrams per liter (mg/L). Throughout the study period, the retention pond substantially prevented the migration of nutrients to neighboring fields surrounding the pond. Unlike the grassed waterway, the retention pond has been shown to be extremely effective at restricting P transport in surface runoff from the nearby poultry houses through dilution by the pond's volume and biological assimilation within the pond. Although the design and installation of retention ponds can create considerable expense for an individual farm's budget, the high absolute nutrient reduction potential rating for this CP, based on collected water quality data, should not be overlooked.

Runoff Diversion Berms

The Moore farm, owned by family members Curtis, Ralph, and Allan, is in western Washington County in the small town of Lincoln, Arkansas, and produces broilers (Figure 5) and beef cattle along with growing crops, such as corn (*Zea mays* L.) and soybeans (*Glycine max* L.). The farm is in the Illinois River watershed and contains grass-dominated pastures as well. The Moore farm has been active in fostering environmentally conscious agriculture through its involvement with ADFP as well as being acknowledged by agencies, such as the Arkansas Farm Bureau, for its efforts in environmental stewardship.

Studies that ADFP has performed at the Moore farm from 2015 to 2021 entail investigating the effects of a constructed berm on diverting runoff away from a creek that flows into a tributary of the Illinois River. The berm is located adjacent to the poultry houses where the berm intercepts and redirects nutrient-laden runoff to grassed pastures on the

Figure 5. Farm owner Curtis Moore in one of the poultry houses at the Moore farm in Lincoln, Arkansas. Photograph courtesy of Arkansas Discovery Farms.

Figure 6. A "newer" poultry house at the Moore farm with a concrete padded entrance.

Figure 7. An "old" poultry house at the Moore farm with a gravel-based entrance.

farm. The nutrient cycling encourages uptake and assimilation by the grasses and is a key benefit to their implementation. The installation of berms can be inexpensive if one is already present on a farm or at a significant cost due to the need for backhoe operations and other building expenses.

Concrete Padding

Additional ADFP research at the Moore farm involves evaluating the effects of concrete padding installation at the entrances to four new poultry houses on the Moore farm (Figure 6). Though there is no official CP designation, concrete padding is akin to USDA-NRCS CP 561, which involves "Heavy Use Area Protection". The concrete padding serves to assist the cleanup of litter that may spill throughout poultry-house cleanout activities. The old houses have gravel dominated entryways, which make litter spillage less manageable (Figure 7). In addition to alleviating litter cleanup, concrete pads can also reduce soil erosion by providing a level surface in which to slow water movement during potential runoff events, a situation that is exacerbated by sloped surfaces of gravel and/or dirt. The cost of installing concrete pads is intermediate compared to grassed waterways and retention ponds due to material expenses and labor. The USDA-NRCS unit cost share for this CP is $0.62 per square foot ($ft^2$).

Statistically analyzed concentrations of NO_3-N, TN, DP, and TP for gravel-based entrances to older poultry houses (Old Houses) and concrete-padded entrances to newer houses (New Houses) from 2015 to 2021 are displayed in Figure 8. Two sampling stations, each one adjacent to the older or newer houses, collected runoff water from the entrances during individual runoff events. Figure 8 shows that the concrete pads have significantly reduced NO_3-N, TN, DP, and TP concentrations from the newer houses compared to the older ones with gravel-dominated entranceways. Therefore, the absolute nutrient reduction potential rating of high for this particular CP, based on collected and analyzed water quality data for the Moore farm, appears to be justified.

Conclusions

Applied conservation practices have the potential to alleviate agricultural concerns in areas such as nutrient loading and soil health status. However, just because a conservation practice may benefit one farming operation,

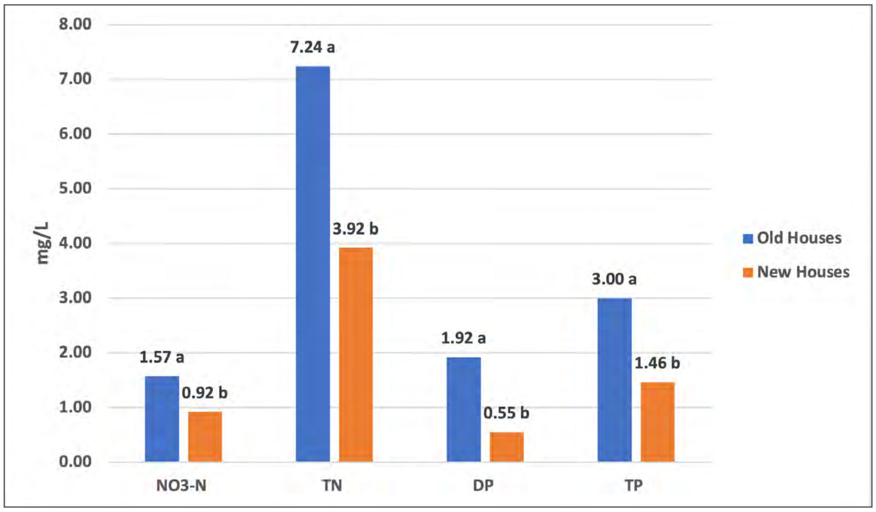

Figure 8. Average Lincoln nutrient concentrations of nitrate-nitrogen (NO_3-N), total nitrogen (TN), dissolved phosphorus (DP), and total phosphorus (TP) in milligrams per liter (mg/L) for gravel-based poultry house entrances (Old Houses) and newer poultry houses with concrete-padded entrances (New Houses) at the Moore farm. Data collected and statistically analyzed from 2015 to 2021. Bars for an analyte with different letters are significantly different at $P \leq 0.05$.

the same conservation practice may not be feasible for another farming operation. Although agriculture in northwest Arkansas is primarily dominated by poultry production, the terrain and topography in the region can vary extremely from farm to farm. Therefore, before any conservation practices are set to be implemented on a particular farm, information about land area characteristics, soil structure parameters, and their potential implementation expense should be considered. This can be accomplished at no charge by requesting a farm conservation plan from NRCS.

Landowners can receive financial assistance from NRCS for conservation practices, such as those featured in this fact sheet, based on qualification through the EQIP or other NRCS programs. Contact your local USDA Service Center for more details and information about unit cost shares of various conservation practices. For questions about soil testing or forage and hay production, please contact your County Agent at your local Extension office.

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