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INSIDE

Decorative trees and shrubs could supplement farm income

and protect the environment

by G. Tom Tabler, Center of Excellence for Poultry Science, University of Arkansas

Introduction

Producers sometimes consider land taken out of production for windbreak establishment nonproductive because it doesn't provide direct income. Growing income-generating plants in the windbreak might change that view. Decorative branches from woody perennial shrubs are becoming extremely popular for use by the florist industry in floral arrangements. Trends in floral design have increased the demand for branches from a number of shrubs with decorative flowers and fruits, as well as branch form and color. Perhaps producers could screen their operation from public view, reduce movement of odors, dust and noise off-site, and provide extra income all at the same time.

Windbreaks and Production Facilities

Without wind management, air movement causes odors emitted from livestock facilities and manure storage areas tend to travel along the ground as a plume. A properly designed windbreak will slow odor movement from livestock facilities. Windbreaks also create an obstacle for fresh, outside air masses forcing them up and over the tree row to create a moderate, evenly distributed, gentle airflow through the trees. The slow air movement past production facilities tends to dilute and reduce the movement of odor, dust and noise offsite. Ideally about 60 percent of the wind should be deflected up and over the windbreak while 40 percent should pass through the canopy of the trees (Missouri NRCS, 2004). While windbreaks are less effective at odor reduction when wind is minimal, the visual screening remains a benefit.

Although the idea of placing vegetative windbreaks around agricultural buildings and farm fields is not new, additional benefits from farm windbreaks continue to be discovered. Windbreaks alone will not prevent odor problems associated with intensive livestock production, but may provide farmers with a tool to improve their image with surrounding communities. Missouri NRCS (2004) reports that windbreaks can reduce the effects of livestock odor and improve visual perception of production buildings in the following ways:

1. Dilution and dispersion of gases and odors by a mixing effect created by windbreaks.

2. Deposition of odorous dusts and aerosols on leaves, needles and branches of plants on the inside of windbreaks.

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. . . helping ensure the efficient production of top quality poultry products in Arkansas and beyond.

3. Collection and storage within tree wood of the chemical constituents of odor pollution.

4. Containment of odor at the source.

5. Aesthetic appearance:

- Trees create a visual barrier to livestock facilities
- Trees can make cropped fields and pastures more visually pleasing
- Trees represent an "environmental statement" to neighbors that the producer is taking the initiative to address nuisance problems.
- Using Trees and Floral Shrubs in Arkansas Windbreaks

The U.S. public is increasingly concerned about the interaction of agricultural activities with the environment, rural communities, consumer health, worker safety, and ethics (NRC, 1996). Many problems the general public associates with poultry production (air quality, water quality or litter management) are cause for concern among Arkansas poultry producers. Given these circumstances, screening farming operations from public view should certainly be given consideration by producers.

At least one row of an evergreen variety should be considered in the windbreak for year round poultry house screening. However, additional rows of decorative woody florals might also be planted. Decorative woody florals are specialty forest products that might also be considered as income producers and to help recoup some of the establishment costs. Essentially, decorative woody florals are any plant species that has a colorful or unusually shaped stem that could become a decorative product. Josiah (2002) indicated that florists pay wholesalers $0.60-$0.80 per 4'-5' stem of corkscrew willow (Salix matsudana) or pussy willow (Salix caprea), with larger stems bringing more. Holly (Ilex spp.) and flowering branches of apple (Malus spp.), cherry (Prunus spp.), pear (Pyrus spp.) as wells as other spring flowering trees or shrubs might command even higher prices. A survey of wholesale and retail florists in Nebraska (a relatively less populated state) indicated a market of approximately 225,000 woody stems sold annually (Lambe and Josiah, 2001). There is also the possibility that the neighbors who bought the small tract of land next door to build a new house might follow the leader and plant their own floral windbreak, further screening nearby agricultural operations.

Poultry producers are accustomed to the long hours and hard work it takes to be successful; however, marketing decorative woody florals (DWF) presents a new challenge. Timing of harvest, perishability of product, labor availability, wildlife pressure, insects and disease, year-to-year production variability, and lack of formalized subsidy or crop insurance programs all require planning and management. Most DWF markets are "niche" in nature, successfully addressing these markets will require producers to spend time to understanding these markets and promoting their product. Josiah (2001a) recommends lining up markets before production investments are made since smaller niche markets may be easily overwhelmed by excessive supply and prices can be volatile depending on product supply and quality. Essential questions to ask to understand potential customers include (Josiah, 2001b):

- ✦ To whom are we marketing?
- ✦ To whom are we not marketing?
- ✦ What are they like?
- ✦ What do they like?
- ✦ What are their current wants and needs?
- ✦ What are their perceptions?
- ✦ Do/Can our products meet their expectations?

Armed with this information, chances are you can better identify areas in which you can successfully compete (e.g., timing, quality, freshness, new products, lower transport costs, etc).

Unfortunately, there is limited information available about this type enterprise and little money to support broader research, development, and transfer of knowledge. This would seem to provide an opportunity for researchers, Cooperative Extension and others to begin to document information on prices and production and provide it to the public, particularly agricultural producers and acreage owners, in a useful format (Josiah, 2002).

The University of Nebraska-Lincoln is studying 45 species or cultivars of trees and shrubs adapted to the Midwest and Great Plains that produce commercially valuable non-timber forest products (Rixstine, 2003). Products from the plantings are harvested as they mature, permitting opportunities to evaluate plant response to harvesting and a better understanding of market characteristics such as quality criteria, demand, pricing, seasonality, market location and capacity. Harvests of a number of the decorative florals began just two years after planting, whereas timber-type species may take 50-80 years to mature. Three years after planting in the Nebraska trial, the most productive species and one of the species with the greatest demand (scarlet curls willow) produced gross income of nearly $5.00/linear foot of planting along the row with plants spaced at 5 feet apart within the row (Josiah et al., 2004). Nebraska researchers estimate that, once established, they could supplement a family's annual income by $5,000 to $15,000, if they are willing to do a month's work of hand-harvesting in late fall and early winter, and then market the fresh product to wholesale or retail florists (Rixstine, 2003). For such an undertaking to work in Arkansas, species or cultivars adapted to the Arkansas climate would have to be used and researchers and Extension personnel with proper expertise would need to assist producers.

Summary

Windbreaks are an option that many poultry producers should consider, especially those with operations along and near roadways in clear public view. Windbreaks can screen poultry houses and improve visual perception of farming operations. Dust, noise and odors leaving an operation may also be reduced. A new twist on windbreak plantings is to incorporate decorative woody florals or other non-timber forest products that may generate supplemental income in a relatively short period after establishment. This could prove beneficial to poultry producers from both an environmental and economic standpoint.

References

Josiah, S. J. 2001a. Productive conservation: Growing specialty forest products in agroforestry plantings. School of Natural Resource Sciences and Cooperative Extension, University of Nebraska-Lincoln. 4 pages.

Josiah, S.J. 2001b. Marketing specialty forest products. School of Natural Resource Sciences and Cooperative Extension, University of Nebraska-Lincoln. 4 pages.

Josiah, S. J. 2002. Non-timber forest products in the Midwest and Great Plains. University of Nebraska/ Cooperative Extension Service/ Kimmel Education and Research Center.

Josiah, S. J., R. St-Pierre, H. Brott, and J. Brandle. 2004. Productive conservation: Diversifying farm enterprises by producing specialty woody products in agroforestry systems. J. Sustainable Agri. 23(3):93-108.

Lambe, D., and S. J. Josiah. 2001. Woody decorative floral markets in Nebraska. Final Report. School of Natural Resource Sciences, University of Nebraska- Lincoln.

NAC. 2003. Working trees for agriculture. USDA National Agroforestry Center (NAC), East Campus-University of Nebraska-Lincoln, Lincoln, NE.

NAC. ND. Working trees for carbon: Windbreaks in the U.S. USDA National Agroforestry Center (NAC), East Campus-UNL, Lincoln, NE.

NRC.1996. Colleges of agriculture at the land grant universities: Public service and public policy. Committee on the future of the colleges of agriculture in the land grant university system. National Academy Press, Washington, D.C.

NRCS, Missouri. Using windbreaks to reduce odors associated with livestock production facilities. Windbreak/shelterbelt-odor control. Conservation practice information sheet (IS-MO380).

Rixstine, B. 2003.Woody shrubs valued for outdoor conservation, indoor decoration. Connect 3(1):1, February. University of Nebraska Cooperative Extension.

Susan Watkins
Department of Poultry Science • University of Arkansas

Clean water lines for flock health

Providing a clean, safe and sanitized water supply is crucial in assuring flocks perform at their best.

Providing a clean, safe and sanitized water supply is crucial in assuring flocks perform their best. However, before implementing a daily water sanitation program, it is important to thoroughly clean as much of the water distribution system as possible. Line cleaning is necessary before providing birds with sanitized drinking water because even low levels of sanitizer placed in dirty water lines can result in the biofilm sloughing off, which clogs drinkers so that water is restricted to the birds. Another impact of adding sanitizers to water intended for bird consumption is that the sanitizer can actually react with the biofilm and result in off tastes that back birds off water. Effectively cleaning the water system (including the drinker lines) helps remove biofilm and scale build-up that can act as a food source and hiding place for harmful pathogens such as E. coli, Pseudomonas or even Salmonella. Many disease causing organisms like Salmonella can live for weeks in water line biofilm resulting in a continuous source of contamination. In addition, proper line cleaning can help prevent calcium deposits or scale build-up which can reduce pipe volume by as much as 70-80%. Yet the use of cleaning products present some dangers since, many of the popular water additive products such as acids and performance enhancers can create conditions favorable for the growth of yeasts and molds, if they are present. Yeasts and molds can actually thrive in low pH water resulting in a gooey slime that will clog drinkers and generally create disaster in water systems. The bottom line is water systems must be properly cleaned between flocks.

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Where to Start

To assure lines are effectively cleaned, the first step is answer the following series of questions.

1. What is the water source?

Untreated well water (i.e. water that is not treated with any type of daily sanitizer product) is the most vulnerable to the formation of slime or biofilm in the drinker lines. While most municipal or rural water supplies contain a minimum of 0.2 ppm free chlorine which greatly reduces bacteria growth, poultry drinking water is handled differently (slow flow and warmed during brooding) from the water supply that goes to a home. Thus, it is unwise to assume that cleaning of drinker lines is not needed.

2. What is the mineral content of the water supply?

The minerals calcium and magnesium are the sources of scale, a hard white build-up. If the water supply contains more than 60 ppm of either or both these minerals and the water pH is above 7 then chances are good that there is scale in the water system that will have to be removed with an acid cleaner designed for nipple drinker systems. Other common mineral contaminants are iron, manganese and sulfur. Iron results in a rusty brown to red colored residue, while manganese and sulfur can form black colored residues. Natural sulfur in the water should have a smell similar to a match head. If the water smells like rotten eggs, then the culprit is hydrogen sulfide. Hydrogen sulfide is a by-product of sulfur loving bacteria and the lines will need to be cleaned with a strong sanitizer. It might even be necessary to shock chlorinate the well. If the filters at the beginning of the water lines are rusty or black colored, then a strong acid cleaner should be used after the sanitizer flush.

3. What products have been used in the water system?

If additives such as vitamins, electrolytes, sugar based products, mineral based performance enhancers or weak concentrations of water acidifiers have been used frequently, then chances are a biofilm is present. Once a biofilm is established in a water system, it makes the system 10-1000 times harder to clean. It is important to play it safe and use strong sanitizer cleaners.

4. Have there been health issues flock after flock such as E. coli, necrotic enteritis or respiratory challenges that do not respond to good management, clean-out or down-time?

The culprit for these problems may be hiding and thriving in the water supply, particularly the water regulators and drinker lines. Cleaning with a strong sanitizer is definitely an option that might help.

Choosing a Product

After identifying the type of cleaning that will be most beneficial, the next step is to choose a product that will not damage the equipment. Currently there are several acid products that can be used for scale removal. Check with your local animal health product supplier for options. Just remember that in order for the product to be effective in removing scale, it needs to drop the water pH below 6. While a strong bleach solution might be effective in removing biofilm, the potential damage it can do to the regulators and nipple drinkers makes this a poor option and the same is true for many cleaners that might otherwise be good poultry barn disinfectants. Iodine is not very effective against biofilms so it makes a poor choice. Currently there are several sanitizer products available for cleaning drinker systems, but some of the most effective products which are not damaging to the drinker systems are the concentrated, stabilized hydrogen peroxides. The active ingredients in these products are different from over-the-counter hydrogen peroxide because the stabilizer keeps the sanitizer from converting to water and oxygen before it finishes the cleaning job. There are also several chlorine dioxide products available, but they are most effective if an acidifier is present which may require dual injectors or a way to safely mix the products prior to injection. A third product used by the industry is household ammonia. A quick test on algae showed that running one ounce of ammonia in every gallon of water was not nearly as effective as a 3% ammonia solution. However it is strongly recommended that the equipment manufacturer be consulted before using this. The most important fact to remember is biofilms or established growth of bacteria, molds and fungus in water systems can only be removed with cleaners that contain sanitizers. It also should be a product and concentration that will not damage the equipment. Pay close attention to any product safety recommendations and follow them accordingly.

Cleaning the system

After the birds are removed from the house, it is time to clean the system. First flush the lines with water. Use a high pressure flush if available. This will remove any loose sediment from the lines. Also make sure the standpipes are working properly to assure any air build-up that may occur during the cleaning process will be released from the lines.

Next, determine how the cleaner will be injected. If a medicator is used, it may not provide the concentration of cleaner necessary, therefore use the strongest product available to overcome the dilute injection rate of the medicator. A very effective alternative is mixing the cleaner in a 55 gallon barrel or 100 gallon stock tank and then using a sump pump to charge the product either into individual lines or through the water tap where the medicator attaches to the water line.

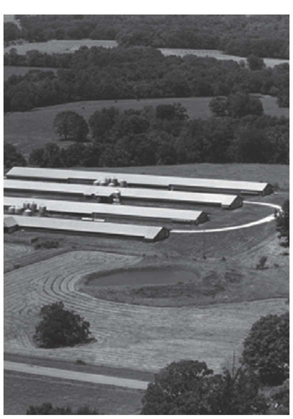
A 400 foot house will require approximately 60 gallons of water to clean the lines and a 500 foot house needs approximately 75-80 gallons of water. A third option is pumping the cleaner from the well room through an injector or medicator. This is a good idea because it cleans the water lines going to the poultry house, which can be a source of contamination. This can be a bad idea if the distribution lines are very dirty since it will send the filth into the poultry house water lines. Use this option only if there is a faucet in the poultry barn that can be used to flush the water lines before water reaches the nipple drinker lines. In a 400 foot poultry house it takes approximately 7 gallons of water per line. So eight 180 foot lines will require approximately 56 gallons of prepared cleaning solution. Use a broom to sweep the nipple drinkers in order to get the cleaning product down into the drinkers. Once the drinker lines are filled with the cleaning solution, let it stand as long as possible with 72 hours being ideal. However check with the product manufacturer to assure this will not damage the equipment. After the lines are cleaned, if mineral build-up is an issue, then re-clean the lines with the acid cleaner.

Keeping the System Clean

Cleaning the water lines between flocks is only half the battle. Even with a thorough cleaning, if a significant number of bacteria, fungi or yeasts are still present, then the biofilm has the potential to return completely in 2-3 days. Therefore the last step is to establish a daily water sanitation program. This will benefit both the birds and the water system.

G. Tom Tabler, Manager, Applied Broiler Research Unit - Savoy
Department of Poultry Science • University of Arkansas

Poultry producers at environmental crossroads



Introduction

While poultry producers have always realized that they are part of a larger production system, animal agriculture today is much different than in the past. Fifty years ago few worried much about food safety, economies of scale, consumer buying habits, international markets, environmental regulations, or the overall structure of various segments of the livestock industry. Today, producers must be concerned with all these factors as well as the day-to-day management of their operations. Producers are under heavy pressure from numerous fronts to minimize the impacts of their operations on the environment.

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The 2002 agricultural census indicated the percentage of farms with livestock has dropped significantly in the past 50 years (NASS, 2002). Farms keeping poultry have dropped from 78 to 4.6%. Fewer and larger livestock farms, coupled with an increasing number of rural residents without livestock, presents significant challenges to the quality of life for both farm and rural non-farm neighbors (Hogberg et al., 2005). Neighbors often have little tolerance for what once was "just part of doing business" in raising poultry, cattle, hogs or other livestock species. Dramatic changes in livestock production have forced many producers to consider getting out of the business.

Changing Structure of Animal Agriculture

Cowling and Galloway (2001) reported that during the last several decades, three enormous changes in the structure and organization of animal agriculture have occurred:

1) Intensification – development of increasingly large confined animal feeding operations in which hundreds or thousands of like animals are reared in feed lots or enclosed housing units.
2) Decoupling – physical separation of the land area where the feed grains or other forage products are produced from the site where the food animals are fed and reared.
3) Transport – huge increases in the distance of transport of both feed materials and marketable meat, eggs, milk, dairy, and fish products.

These trends, like almost everything else in the business world today, are driven by economic efficiency. However, such economic efficiency is often made possible by increased use of energy (particularly fossil fuels) and frequently leads to nutrient-use inefficiencies with largely unforeseen detrimental environmental consequences (Cowling and Galloway, 2001). This point is driven home almost daily as producers and integrators are portrayed as the "bad guys," rather than the ones who supply food for the grocery store shelves.

Today, concentrated animal feeding operations (CAFOs) account for more than 40 percent of world meat production, up from 30 percent in 1990. For the poultry sector alone, global poultry population has grown from 4.2 billion birds in 1961 to 17.8 billion birds in 2005 (Hegg, 2006). In the U.S., many specialized, large poultry operations (4 to 10-house farms or larger) may lack adequate land base for appropriate litter or manure application. In the near future, this may mean a change in the structure of livestock production and/or forced adoption alternative technologies to ensure that litter is managed to meet water and air quality standards.

The demand for agricultural operations to comply with air pollution regulations is often perceived by producers as inappropriate or unfair; threatening the economic viability of rural residents, small communities and regional economies, and perhaps the overall production of food by the U.S. (Aneja et al., 2006). Poultry producers struggle daily with trying to manage litter and manure generated on their operations in such a way as to meet both air and water quality standards that may not agree with or compliment one another. How productive and/or efficient is it to address a water quality issue that has, as a consequence, a negative effect on air quality? Programs that do not jointly address air and water quality issues may be too costly to implement for both producers and society. Unfortunately, the current scientific knowledge about nitrogen, volatile organic compounds, sulfur, and particulate matter emissions from intensively managed agriculture is insufficient and the ultimate fate of these compounds from an air quality standpoint is directly comparable to the situation in the 1980s with regard to agricultural non-point sources of nutrient contamination of water. There is just enough information for researchers and policy makers to recognize a serious problem, but not enough information for them to understand the extent of the problem or to make scientifically credible recommendations about potential solutions (Aneja et al., 2006). The situation was made even tougher recently by a final rule from the EPA released Sept. 21, 2006 that places agricultural dust in the same category as coarse particulate matter found in urban areas and holds it to the same standard. The limit of 150 micrograms per cubic meter during a 24-hour period will be extremely difficult to meet in rural areas that often are naturally dusty (Anonymous, 2006).

Challenges and Opportunities

The major challenge affecting animal production in the future will likely be environmental. How do producers manage waste materials in response to ever increasing regulatory and public pressure? Unfortunately, in spite of major changes in animal agriculture, few incentives for recycling nutrients in animal waste have surfaced. As a result, often times valuable nutrients in animal waste have been spread to excess on land near where the waste was generated. Society should today view animal waste, as it once did, as a valuable resource to be conserved, not as a waste disposal problem to be eliminated by the cheapest method available. This will require some innovative thinking, but we are certainly capable of that. Additional challenges include better informing the general public about the complexity of modern-day animal agriculture as well as creating better dialogue between producers and their non-farm neighbors. This is where extension personnel at the local and state level may be of valuable assistance to producers, community leaders, and politicians.

Fortunately, economically viable technologies are being developed for conservation and profitable reuse of nitrogen, phosphorus, carbon and other valuable nutrients in animal wastes (Cowling and Galloway, 2001). Animal wastes are of three general types:

1) Animal manures,
2) Waste streams from processing plants that include, blood, bones, feathers, offal and other un- or under-used portions of harvested animals, and
3) Animal carcasses.

Opportunities exist because the nutrients from all of these waste streams can be recovered and reused. Value-added end products could be produced by converting nutrients in animal wastes into saleable energy, electricity, fertilizer, or feed materials for livestock (Sheffield, 2000; Cowling et al., 2001). The most serious obstacles to overcoming the consequences of intensification, decoupling and transport in the food animal industry are (Cowling and Galloway, 2001):

1) Distances over which feed grains are transported before delivery to animal rearing facilities – sometimes in another state or country,
2) Reluctance or doubt among farmers, integrators and others about the technical and/or economic feasibility of alternative systems for nutrient management, animal production, or waste utilization,
3) Lack of convenient processes for combining manure-based fertilizer products with synthetic chemical fertilizer in intensively managed cropping systems.

Forces of Change

The Farm Foundation (2006) has identified nine forces of change affecting environmental issues related to animal agriculture in North America. Each will have important implications for the industry during the next decade.

1) Farm concentration and specialization
2) Uncertainty about human health connections
3) Advances in animal operations technologies
4) Environmental activism and information technologies
5) Litigation
6) Changing perception of agriculture
7) Changing measurement technologies
8) Resource constraints
9) Uncertainty about evolution of Kyoto Treaty Implementation

Poultry producers and integrators are at a crossroads. All livestock producers should closely monitor any talk and events related to environmental and waste management issues. Some producers have closed their operations or sold out and more may follow to avoid entanglements with neighbors or possible litigation. Unfortunately for those who choose to remain in business, additional regulations will likely increase costs of production, reduce economic opportunities and increase the difficulty of remaining a viable farming operation. This is particularly true in traditional poultry producing regions like Arkansas which, in some localized areas, already have large nutrient surpluses and transporting poultry litter out of the region is expensive. Stricter regulations and the likelihood of litigation may be seen by integrators as an unfriendly or unstable business climate, perhaps forcing the relocation of facilities to more friendly business climates. Such a relocation would be detrimental for producers, consumers and ultimately, entire communities as well.

Summary

Intensification, decoupling and transport have greatly reshaped the face of animal agriculture over the last several decades. With these changes have come economic efficiencies along with recently recognized nutrient-use inefficiencies as well as some detrimental environmental consequences. The most serious challenge facing poultry producers in the future may be environmental – how to best manage litter, manure, dust and odors in response to increasing regulations and continued public pressure. Poultry producers should monitor the situation closely and may likely see costs of production increase as new regulations are handed down. Many producers will likely face difficult decisions as to whether or not to continue poultry farming.

References

Aneja, V. P, W. H. Schlesinger, D. Niyogi, G. Jennings, W. Gilliam, R. E. Knighton, C. S. Duke, J. Blunden, and S. Krishnan. 2006. Emerging national research needs for agricultural air quality. EOS. Vol. 87, No. 3, Jan 17.

Anonymous. 2006. EPA says don't stir the dust. Beef Business Bulletin. 30(1):1. Oct 12.

Cowling, E. B., D. Botts, K. A. Cochran, S. J. Levitas, J. Rudek, and W. W. Heck. 2001. Concept Paper: A strategy to facilitate the transition of the North Carolina swine industry to an economically and environmentally sustainable system of waste management. North Carolina State University, Raleigh, NC.

Cowling, E. B., and J. N. Galloway. 2001. Challenges and opportunities facing animal agriculture: Optimizing nutrient management in the atmosphere and biosphere of the Earth. Symp. Animal Production and the Environment: Challenges and Solutions. ASAS Annual Meeting, Indianapolis, IN. July 24-28.

Farm Foundation. 2006. Future of Animal Agriculture in North America, Environmental Chapter. 1211 W. 22nd Street, Suite 216, Oak Brook, IL.

Hegg, R. 2006. The future of animal agriculture and the environment. The John M. Airy Beef Cattle Symposium: Visions for Animal Agriculture and the Environment. January 2006. Kansas City, MO.

Hogberg, S. L. Fales, F. L. Kirschenmann, M. S. Honeyman, J. A. Miranowski, and P. Lasley. 2005. Interrelationships of animal agriculture, the environment, and rural communities. J. Anim. Sci. 83(E. Suppl):E13-E17.

NASS. 2002. Census of Agriculture. Natl. Agric. Stat. Serv., USDA, Washington, DC.

Sheffield, J. 2000. Evaluation of comprehensive approaches needed to improve the handling of farm animal manure and benefit the environment and the farming industry. Joint Institute for Energy and Environment. University of Tennessee, Knoxville, TN.

G. Tom Tabler
Center of Excellence for Poultry Science • University of Arkansas

Ammonia emissions attracting significant attention

Introduction

Farmers in all segments of animal agriculture of United States are under pressure to minimize the impact of their farming operations on the environment. Even though most environmental concerns during the past two decades have focused on water quality issues, air quality has recently attracted significant attention, especially ammonia emissions from poultry housing. While agricultural emissions have historically been ignored by United States regulations, recent regulations may signal a change.

Farmers in all segments of animal agriculture of United States are under pressure to minimize the impact of their farming operations on the environment.

Understanding Particulate Matter

We all know about particulate matter in the air, except that we call it dust, smoke, smog or haze. Since dust particles tend to settle out on calm days, while smoke, smog or haze particles remain suspended, it should also be apparent that air contains particles of different sizes. Particles (also called particulate matter or PM) are classified by the approximate diameter of the particles present. There are over 25,000 micrometers in an inch and the diameter of a human hair is usually 50 to 75 micrometers. The size of the particles in air is abbreviated using the particle size (in micrometers) as a subscript. For instance, PM2.5 shows that particles of 2.5 micrometers or smaller are involved.

Particles between 2.5 and 10 micrometers (called "coarse particles") are generated from the soil, factories, roads, row-crop farming operations or rock crushing operations. Smaller particles (PM2.5 or smaller) arise from automobile exhaust, power plants, wood burning, industrial processes, diesel powered vehicles, organic compounds, ammonia emissions, brush fires or volcanic eruptions. Coarse particles may stay suspended in air for a few minutes or hours and travel up to 30 miles, while fine particles can stay in the air for days or weeks and may travel several hundred miles. When animals or humans breathe air containing particulate matter, fine particles penetrate deeper into the lungs than coarser particles and can cause coughing, wheezing, shortness of breath and lung damage (EPA, 2006).

New Air Quality Standards

The National Ambient Air Quality Standards (NAAQS) were issued by the EPA in 1997. The NAAQS were developed for six pollutants that the EPA considered common throughout the United States:

1) Carbon monoxide (CO)
2) Lead (Pb)
3) Nitrogen dioxide (NO2)
4) Ozone (O3)
5) Particulate matter (PM)
6) Sulfur dioxide (SO2)

These pollutants were chosen based on two criteria: the protection of public health; and the protection of public welfare, such as damage to animals, crops, vegetation and buildings or decreased visibility (Mukhtar and Auvermann, 2006).

Since only small amounts of these pollutants are generally emitted directly, these standards would initially appear to have little to do with poultry houses. However, research has shown that ammonia can combine in the air with nitrogen or sulfur oxides to form very small particles (PM2.5's) of ammonium nitrate or ammonium sulfate.

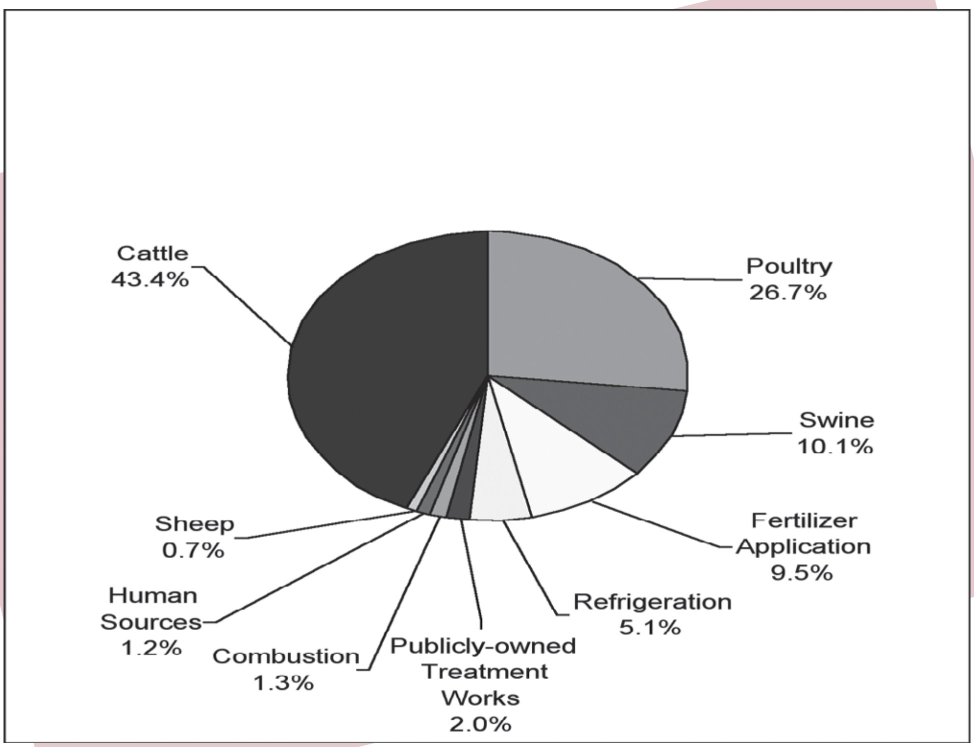
The reaction of ammonia in the atmosphere to form PM2.5's means that the NAAQS regulations aimed at reducing PM2.5 emissions will likely require reductions in ammonia emissions from animal agriculture operations (Gay and Knowlton, 2005).

Ammonia Emissions

Ammonia can travel as far as air can go in 5 or 6 days (Knowlton, 2000). Particle (PM2.5) formation can prolong existence of emissions in the atmosphere and therefore influences the geographic distribution of acidic depositions (Sommer and Hutchings, 2001). This means that ammonia lost from Arkansas poultry farms may be affecting air and water quality in the Midwest or East. Midwestern agricultural practices have, for years, been blamed for eutrophication in the Gulf of Mexico. Problems in the Chesapeake Bay are likely associated, in part, with ammonia deposition from upwind agricultural areas such as Ohio and North Carolina (Gay and Knowlton, 2005).

Dramatic increases in air concentration of ammonia in areas of intensive agriculture have been reported, and estimates indicate that animal agriculture accounts for 50 to 85% of total ammonia volatilization. The loss of gaseous ammonia has direct implications on the nitrogen content and the fertilizer value of animal manure. In addition, a recent study by the National Research Council (NRC, 2003) identified ammonia emissions as a major air quality concern at regional, national, and global levels. It is, therefore, important and in producers' own best interest that animal agriculture takes the ammonia emissions issue seriously. Figure 1 lists estimates of ammonia emissions from man-made sources in the U.S. during 1994. Note that poultry was responsible for almost 27% of total ammonia emissions estimates.

Figure 1. Estimates of ammonia emissions from man-made sources in the U.S. in 1994 (Battye et al., 1994).



Producers are aware from their own experience and estimates confirm that ammonia emissions will change with the seasons, the geographic region, production techniques, manure management practices, the number of animals present and type of animals produced (EPA,

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2004). In general, however, the greatest ammonia losses are associated with land application of manure (35%-45%) and housing (30%-35%; Gay and Knowlton, 2005).

Ammonia Source

Poultry producers deal with ammonia on a daily basis and some may wonder about the source of ammonia. The ammonia is not directly produced or excreted by the birds, but is a common by-product of poultry wastes. Birds excrete waste containing unused feed nitrogen in the form of uric acid. Ammonia is formed through the microbial breakdown of uric acid. Conditions that favor microbial growth will result in increased ammonia production. These conditions include warm temperatures, moisture, pH in the neutral range or slightly higher (7.0 – 8.5) and the presence of organic matter – factors normally present in abundance in poultry waste handling systems (Carey, ND).

What to Do

The frequent and total removal of litter and manure from poultry houses would reduce the ammonia emissions concern. Yet, in most cases, due to the cost of cleanout and replacement bedding, this is not a viable option for most producers that may only clean out once a year or less.

The most appropriate strategy to control ammonia is to reduce ammonia volatilization. A number of compounds are available for use by poultry producers to reduce the pH of poultry litter to promote formation of NH_4^+ ions that will bind to other compounds and thus reduce the amount of volatile ammonia (Carey, ND). However, since manure, which neutralizes these acidifying agents, is constantly produced, these compounds provide pH control for only a short time.

Perhaps the simplest thing most poultry producers can do to minimize ammonia emissions is to control litter moisture. The more moisture there is in the litter, the more potential for ammonia emissions from that litter. Ferguson et al. (1998) confirmed the relationship between higher litter moisture and increased litter ammonia. Increases in litter moisture from approximately 56% to 60% resulted in an increase in litter ammonia release. Keeping the litter dry depends, in part, on how well drinker management is maintained. Closely monitor the drinker height and regulator pressure. Promptly address leaking nipples or lines. Remove wet litter from the house if a major leak or spill occurs.

Also, know what is in the water the birds are drinking. If you don't know, have the water tested to determine its quality. While often overlooked, water quality has a major impact on flock health and performance as well as litter conditions. Ventilation is also critical to maintaining proper litter moisture. Humidity levels must be maintained below 70% to prevent caking. If you do not currently do so, consider using litter amendments to lower the pH early in the life of the flock. This will decrease ammonia emissions and allow you to ventilate for moisture removal instead of ammonia removal which should allow a decrease in fan run time, thereby saving fuel. It will take an integrated approach to reduce ammonia emissions from animal agriculture. Keep in mind there is no one product or management practice that will solve all the problems.

Summary

Meeting new air quality standards and complying with future regulations has the potential to affect practically every farm in America and perhaps put some out of business. Controlling ammonia emissions from poultry and livestock facilities will be a daunting task in the future for livestock producers. Producers will have to use an integrated approach that attacks the problem from several different angles. There are products available to help control litter pH early in a flock. Excellent house management will be required to keep litter moisture at optimum levels.

Producers, not politicians, will ultimately have to solve the air quality concerns associated with livestock production. Increased producer involvement is needed at all levels – local, county, state and national if we are to have workable programs that keep farms viable while benefiting the environment, instead of unrealistic expectations that cannot be met.

References

Battye, R., W. Battye, C. Overcash, and S. Fudge. 1994. Development and selection of ammonia emission factors. EPA/600/R-94/190. Final report prepared for U.S. EPA, Office of Research and Development. USEPA Contract No. 68-D3-0034, Work Assignment 0-3.

Carey, J. B. No Date. Mitigation strategies for ammonia management. Available at: http://gallus.tamu.edu/Faculty/MitigationStrategiesforAmmoniaManagementProceedingsPaper. Accessed October 12, 2006.

EPA. 2004. National emission inventory – Ammonia emissions from animal husbandry. Available at: http://www.epa.gov/ttn/chief/ap42/ch09/related/nh3inventorydraft_jan2004.pdf October 12, 2006.

EPA. 2006. Laboratory and field operations – PM2.5. Available at: http://www.epa.gov/region4/sesd/pm25/p2.htm#2 11/16/06

Ferguson, N. S., R. S. Gates, J. L. Taraba, A. H. Cantor, A. J. Pescatore, M. L. Straw, M. J. Ford, and D. J. Burnham. 1998. The effect of dietary protein and phosphorus on ammonia concentration and litter composition in broilers, Poult. Sci. 77:1085-1093.

Gay, S. W., and K. F. Knowlton. 2005. Ammonia emissions and animal agriculture. Virginia Cooperative Extension, Biological Systems Engineering, Publ. No. 442-110. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Knowlton, K. 2000. Ammonia emissions: the next regulatory hurdle. The Jersey Journal, October 2000, 47:56-57.

Mukhtar, S., and B. W. Auvermann. 2006. Air quality standards and nuisance issues for animal agriculture. Texas Cooperative Extension Service, Publ. No. E-401. Texas A&M University System, College Station, TX.

NRC. 2003. Air Emissions from Animal Feeding Operations. The National Academies Press. Washington, DC.

Sommer, S. G., and N. J. Hutchings. 2001. Ammonia emission from field applied manure and its reduction – invited paper. European Journal of Agronomy 15:1-15.

Write Extension Specialists, except Jerry Wooley, at:
Center of Excellence for Poultry Science
University of Arkansas
Fayetteville, AR 72701

UA Poultry Science Extension Faculty

Dr. R. Keith Bramwell, Extension Reproductive Physiologist, attended Brigham Young University where he received his B.S. in Animal Science in 1989. He then attended the University of Georgia from 1989 to 1995 where he received both his M.S. and Ph.D. in Poultry Science. As part of his graduate program, he developed the sperm penetration assay, which is still in use today, as both a research tool and as a practical troubleshooting instrument for the poultry industry. He then spent one year studying in the Animal Reproduction and Biotechnology Lab at Colorado State University. In 1996, Bramwell returned to the University of Georgia as an Assistant Professor and Extension Poultry Scientist. Dr. Bramwell joined the Center of Excellence for Poultry Science at the University of Arkansas as an Extension Poultry Specialist in the fall of 2000. His main areas of research and study are regarding the many factors (both management and physiological) that influence fertility and embryonic mortality in broiler breeders. Telephone: 479-575-7036, FAX: 479-575-8775, E-mail: bramwell@uark.edu

Dr. Dustan Clark, Extension Poultry Health Veterinarian, earned his D.V.M. from Texas A&M University. He then practiced in Texas before entering a residency program in avian medicine at the University of California Veterinary School at Davis. After his residency, he returned to Texas A&M University and received his M.S. and Ph.D. Dr. Clark was director of the Utah State University Provo Branch Veterinary Diagnostic Laboratory prior to joining the Poultry Science faculty at the University of Arkansas in 1994. Dr. Clark's research interests include reoviruses, rotaviruses and avian diagnostics. He is also responsible for working with the poultry industry on biosecurity, disease diagnosis, treatment and prevention.
Telephone: 479-575-4375, FAX: 479-575-8775, E-mail: fdclark@uark.edu

Dr. Frank Jones, Extension Section Leader, received his B.S. from the University of Florida and earned his M.S. and Ph.D. degrees from the University of Kentucky. Following completion of his degrees Dr. Jones developed a feed quality assurance extension program which assisted poultry companies with the economical production of high quality feeds at North Carolina State University. His research interests include pre-harvest food safety, poultry feed production, prevention of mycotoxin contamination in poultry feeds and the efficient processing and cooling of commercial eggs. Dr. Jones joined the Center of Excellence in Poultry Science as Extension Section Leader in 1997. Telephone: 479-575-5443, FAX: 479-575-8775, E-mail: ftjones@uark.edu

Dr. John Marcy, Extension Food Scientist, received his B.S. from the University of Tennessee and his M.S. and Ph.D. from Iowa State University. After graduation, he worked in the poultry industry in production management and quality assurance for Swift & Co. and Jerome Foods and later became Director of Quality Control of Portion-Trol Foods. He was an Assistant Professor/Extension Food Scientist at Virginia Tech prior to joining the Center of Excellence for Poultry Science at the University of Arkansas in 1993. His research interests are poultry processing, meat microbiology and food safety. Dr. Marcy does educational programming with Hazard Analysis and Critical Control Points (HACCP), sanitation and microbiology for processing personnel. Telephone: 479-575-2211, FAX: 479-575-8775, E-mail: jmarcy@uark.edu

Dr. Susan Watkins, Extension Poultry Specialist, received her B.S., M.S. and Ph.D. from the University of Arkansas. She served as a quality control supervisor and field service person for Mahard Egg Farm in Prosper, Texas, and became an Extension Poultry Specialist in 1996. Dr. Watkins has focused on bird nutrition and management issues. She has worked to identify economical alternative sources of bedding material for the poultry industry and has evaluated litter treatments for improving the environment of the bird. Research areas also include evaluation of feed additives and feed ingredients on the performance of birds. She also is the departmental coordinator of the internship program.
Telephone: 479-575-7902, FAX: 479-575-8775, E-mail: swatkin@uark.edu

Mr. Jerry Wooley, Extension Poultry Specialist, served as a county 4-H agent for Conway County and County Extension Agent Agriculture Community Development Leader in Crawford County before assuming his present position. He has major responsibility in the Arkansas Youth Poultry Program and helps young people, parents, 4-H leaders and teachers to become aware of the opportunities in poultry science at the U of A and the integrated poultry industry. He helps compile annual figures of the state's poultry production by counties and serves as the superintendent of poultry at the Arkansas State Fair. Mr. Wooley is chairman of the 4-H Broiler show and the BBQ activity at the annual Arkansas Poultry Festival.
Address: Cooperative Extension Service, 2301 S. University Ave., P.O. Box 391, Little Rock, AR 72203