SITE SELECTION OF ANIMAL OPERATIONS USING AIR QUALITY CRITERIA

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The siting of new animal production facilities and expansion of existing facilities in the United States has become increasingly difficult due to the air quality concerns of residents surrounding livestock and poultry operations. Such concerns often include the effects of nuisance odors on quality of life and the effects of odors and manure gases on both human health and the environment. This white paper primarily addresses the development of setback distances with regard to nuisance odor issues, although some general discussion on human health issues related to emissions from animal production sites is included. Environmental concerns such as water quality impacts and recreational land-use issues stemming from livestock and poultry facility emissions are only mentioned and not fully discussed.

Consolidation of the poultry, beef, swine and, most recently, dairy industries has led to significant changes in animal production. Most animals are now raised in specialized production facilities that are, in the opinion of most animal producers, a vast improvement over traditional housing systems, where animals were exposed to pathogens, parasites and predators and subjected to harsh weather extremes. The transition to intensive rearing of animals has been overwhelmingly positive for the livestock industry: Animal mortality rates have been reduced, feed efficiencies have improved and productivity has increased. However, new problems have arisen for the industry, one of which is the impact of animal-based agriculture on air and water quality, which subsequently affects the siting of animal production operations.

In modern animal housing systems, manure is often removed from the buildings to provide more sanitary growing conditions. This is done either quickly by gravity (through concrete slats) or on a daily or weekly basis by mechanically scraping floors. The liquid manure or slurry removed from buildings is often stored outside in earthen basins, in above-ground storages or in-ground concrete tanks. Slurry may also be stored in concrete pits beneath livestock buildings. Some animal housing systems, particularly poultry buildings, allow solid manure with large amounts of bedding to accumulate on the floors. Any animal facilities, especially those that store either solid or liquid manure inside the building, must be ventilated to remove manure gases, moisture and heat from the indoor air to provide a healthy environment for the animals housed. As a result, odors and gases are inherently released from animal housing during this air exchange.

Manure produced in animal production facilities that is not stored is collected regularly, usually daily, and spread on cropland. However, daily or frequent hauling and application of manure is not an option for most livestock producers due to agronomic considerations, weather conditions or labor concerns. If the animal producers raise crops, there is typically no available cropland on which to spread manure during the growing season, so manure storage is necessary. In a vertically integrated animal production system, private landowners contract with companies to provide land, facilities, utilities and labor in return for a fee to finish the animals (Barker, 2000). These producers no longer grow crops that are directly fed to the animals raised in their buildings, but rather receive formulated feed from the companies' mills. Some animal production systems have become much larger without a corresponding increase in their land base, thus relying on agreements with neighboring crop

farmers to apply manure to the neighbor's cropland. If the manure is utilized either on the animal producers' land or someone else's, it typically must be stored for several months before it can be spread. The manure storage units necessary for this storage have become a significant source of odor and gas emissions.

The establishment of setback distances based on airborne emissions from animal production units requires knowledge of federal, state and local concentration or emission standards. The regulation of air emissions requires enabling legislation, rules and regulations, and an enforcement process (Lesikar et al., 1996). Congress passed the original Clean Air Act in 1955 and has subsequently amended the act to regulate air pollution at the federal level. The Environmental Protection Agency (EPA) is directed to interpret the intent of congressional legislation related to environmental matters and to formulate the rules and regulations that implement legislation such as the Clean Air Act. This act established ambient air quality standards for six compounds: nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and particulate matter (PM). The PM category was initially for only PM_{10} (particles less than 10 mm in aerodynamic diameter). However, recent concerns about human health effects caused by fine PM (Lippmann et al., 2000) have led the EPA to propose new standards for $PM_{2.5}$ (particles less than 2.5 mm in aerodynamic diameter).

In addition to formulating environmental quality standards, the EPA delegates authority to the states and provides oversight of State Air Pollution Regulatory Agencies (SAPRAs). These agencies must first obtain regulatory authority from their respective state legislatures then formulate rules and regulations in regard to air quality for the state. State air quality standards are often more stringent than the National Ambient Air Quality Standards (NAAQS) set by the EPA and can also include constituents such as odor and gases that are not regulated at the federal level. In reviewing existing state standards for hydrogen sulfide (H_2S), ammonia (NH_3) and odors, we found that 42 of 50 states have standards for one or more of these particular airborne contaminants.

The use of setback distances between livestock and poultry farms and neighboring residences and businesses is the most common method used to reduce the impact of odorous air emissions from animal production sites. Determination of setback distances is difficult and usually involves compromises; large setback distances often restrict the development of new or the expansion of existing animal production sites, while small setback distances are insufficient to mitigate the frequency and severity of nuisance events. The determination of appropriate setback distances is imperative to the viability of the livestock production industry and the quality of life of neighbors. However, many setback distances are determined on the basis of anecdotal and subjective information rather than objective and scientific relationships.

The airborne emissions from animal production sites that should be considered when determining setback distances include odor, gases, dust, insects and microorganisms. The quantity and proportions of these emitted materials are primarily a function of animal species, facility design and management. Odor emissions from animal production sites are probably the most important factor to consider when determining setback or buffer distances from neighbors and communities. Other airborne emissions may have a greater environmental impact, but odor is typically used as an indicator for these other pollutants, and everyone has a sensor for odor.

The establishment or determination of setback distances from animal production facilities can be accomplished using a guideline approach or by the use of dispersion models. Guidelines are used to determine setback distances based on criteria such as parametric formulas based on animal units, animal housing system, physical size of operation or similar parameters. The dispersion model method is a more robust tool that inputs specific airborne emissions such as odor, ammonia or pathogens from the animal production site as well as weather conditions then estimates a concentra-

tion of the pollutant (odor, ammonia, etc.) downstream, which can be used to establish a setback distance.

References

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