Adverse Health Effects Of Hog Production

A Literature Review

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Ammonia emissions from hog farms pose a serious public health threat.

- Ammonia emissions from hog farms react with other gases in the air to form fine particle pollution, a public health threat linked to decreased lung function, cardiovascular ailments and most seriously, premature death.[1]

- Recent analysis by NC State University (NCSU) researchers shows that fine particulate pollution is higher in Raleigh (and likely for all of the Triangle area) when air masses cross the high density hog counties on the way to Raleigh.[2] This analysis also found fine particulate levels in a rural town (Kenansville) in a high density hog county were very high relative to what would be expected.

- The 2003 National Academy of Sciences[3] report identified atmospheric ammonia nitrogen emissions as the most significant public health threat from Animal Feeding Operations on a regional scale.[4]

- Reducing ammonia emissions from Animal Feeding Operations makes sense not only for the obvious public health benefits, but also for economic reasons. The Benefit Cost Analysis conducted by Research Triangle Institute for the NCSU hog waste management evaluations found that a 50% reduction in ammonia emissions from hog farms in eastern NC will provide an estimated $190 million a year in benefits from avoided health impacts.[5]

Air emissions from lagoons, sprayfields and hog houses have been linked to neurological and respiratory problems.

- Subjects in a controlled exposure chamber who were exposed to air from hog operations for one hour reported headaches, eye irritation and nausea.[6]

- Unpleasant odors have been found to be a nuisance and emotional stressor on neighbors,[7] and are known to contain irritants that can cause damage to mucosal linings in the nose, throat and respiratory tract.[8]

- The 2003 National Academy of Sciences report identified odor as the most significant concern for local communities among the suite of air emission problems from Animal Feeding Operations.

- Researchers from the UNC School of Public Health and Duke University found that neighbors exposed to odors from hog operations showed evidence of reduced immune system function.[9]

- Evidence is also emerging that indicates that the health of citizens living near hog operations is negatively affected.[10] Research in Iowa and North Carolina showed that neighbors living within three miles of hog operations experience elevated levels of respiratory complaints relative to those living near other animal production operations or crop production.[11,12]

- Abhorrent odors can be exacerbated by the smell and sight of rotting flesh from hog carcasses that are often stored in “dead boxes” close to neighbors’ property lines. "Dead trucks" that transport hog carcasses to rendering facilities also emit odor.

Hydrogen Sulfide Emissions

- Hydrogen sulfide (H_2S) is a colorless gas with a strong odor of rotten eggs that is detectable at concentrations as low as 0.5 ppb (0.0007 mg/m_3). Acute exposures to H_2S at 2 – 10 ppm have been associated with respiratory and cardiovascular effects, and people with asthma appear to be more sensitive to H_2S reporting headaches following 30 minute exposures to 2 ppm.[13] The EPA also reports that acute occupational exposures have been associated with a variety of central nervous system (CNS) transitory symptoms, such as dizziness, nausea, headache, and at higher exposure concentrations, serious conditions such as “abrupt physical collapse” and pulmonary edema.[14]

- The 2003 National Academy of Sciences report, noting hydrogen sulfide’s risks to public health, recommended that the EPA and USDA should develop process-based mathematical models for atmospheric emissions of hydrogen sulfide, along with ammonia and methane, to identify management changes that decrease emissions.

- Of particular concern is the susceptibility of children to neurological effects associated with H_2S exposure.[15]

- The EPA Office of Air Quality Planning and Standards is in the process of re-evaluating H_2S toxicity to determine if it requires specific regulation.[16] The neurotoxicity has been cited as one of the principle reasons for increased scrutiny.

- In light of these efforts by the EPA Office of Air Quality Planning and Standards, it would seem reasonable and practical to continue to collect emissions data, and use this information in the evaluation of potential health impacts that can be used to inform the decision-making process by the Office of Air Quality Planning and Standards. It is premature to cease collecting this information at a time when an analysis of the exposure conditions is warranted.

Hog waste contains disease-causing pathogens & increases antibiotic resistance.

- Hogs and humans share many of the same disease organisms. Large quantities of antibiotics, many closely related to those used to treat humans, are used by pork and other livestock and poultry producers.[17]

- Environment Defense reported in 2005[18] that North Carolina's animal production industry, which is largely comprised of hog and poultry production, is estimated to use three million pounds of antibiotics annually. This is approximately the same amount of antibiotics that is estimated to be used *nationally* to treat humans.

- The vast majority of antibiotics are administered not to treat disease but rather to promote growth or to compensate for the crowded, stressful and often unhygienic conditions in industrial-scale livestock operations. An expanding body of evidence[19,20] links this frequent exposure of antibiotics to the development of antibiotic-resistant pathogens, contributing to the problem of reduced antibiotic effectiveness in humans, a growing health concern in the United States.

- There are also concerns about the exposure of workers or neighbors to antibiotics in the dust generated in the hog confinement facilities, which are vented to the outdoors.[21,22]

Evidence indicates adverse impacts on workers' and children's health.

- An enormous amount of research exists to document the serious negative impacts to swine confinement house workers.[23] Effects include respiratory symptoms, reductions in pulmonary function and increased bronchial responsiveness.

- Researchers in Iowa found a high prevalence of asthma in children living on hog farms, especially farms that added antibiotics to feed.[24,25]

- A North Carolina study of 58,169 children found a 23% higher prevalence of asthma symptoms among students attending schools where staff noticed livestock odors indoors twice a month or more.[26]

Manure land application rates at hog Animal Feeding Operations result in high levels of pollutants in groundwater and pose risks for drinking water wells.

- Ground water nitrate levels beneath animal waste sprayfields are typically found to range from 10 to 50 parts per million (ppm).[27] The drinking water standard for nitrate is 10 ppm. Even wells drilled to clean aquifers below

surface contaminated groundwater aquifers are at risk because well casing construction flaws can allow leaks of highly contaminated groundwater into drinking water wells.

- Results from a free well-testing program for people living adjacent to hog farms in North Carolina in 1996 found more that 10% of the wells tested failed to meet drinking water standards for nitrate. Three wells had nitrate concentrations in the 70 – 100 ppm range. The NC Department of Health and Human Services found that the results of the well testing program "…*illustrate a potentially serious groundwater problem to the people utilizing wells near Industrial Livestock Operations in five counties in eastern North Carolina*." [28]

Community health experts are recommending safeguards to protect the health of rural residents.

- Based on the 2003 American Public Health Association's review of evidence of the health and economic impacts of concentrated animal feeding operations (CAFOs)[29,30] and "evidence, albeit less certain, indicating impacts on children and CAFO neighbors from exposure to large concentrations of manure and their subsequent emissions of dust, toxins, microbes, antibiotics and pollutants in the air and water," the Association resolved that it would: *Urge federal, state, and local governments, and public health agencies to impose a moratorium on new Concentrated Animal Feed Operations until additional scientific data on the attendant risks to public health have been collected and uncertainties resolved.*

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- The American Public Health Association's recommendations were recently endorsed by a collection of American and European environmental scientists brought together in a symposium and workshop organized by the University of Iowa's Environmental Health Science Research Center and sponsored by the National Institutes of Environmental Health Sciences. The endorsement emerged from an expert community health workgroup assembled at the workshop in 2004, the results of which were recently published.[31] The workgroup found that "…*sufficient research exists to support action to protect rural residents from the negative community health effects of CAFOs*…." Furthermore, the expert workgroup recommended that permitting of CAFOs should include: consideration of total animal density in a watershed; environmental impact statements; public meetings and local decision making; regulation with standards applied to general industry with similar levels of emissions and type of waste handling; and bonding for manure-storage basins for performance and remediation.

[1] Research Triangle Institute, 2003. “Benefits of Adopting Environmentally Superior Technologies in North Carolina,” available at http://www.cals.ncsu.edu/waste_mgt/smithfield_projects/phase1report04/appendix%20c-RTI.pdf.

[2] Goetz, S.B. 2006. Measurement, Analysis, and Modeling of Fine Particulate Matter in Eastern North Carolina Master Thesis. NC State University, Raleigh, NC.

[3] National Academy of Sciences/National Research Council, 2003. National Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs, National Academies Press, available at http://fermat.nap.edu/catalog/10586.html.

[4] Animal Feeding Operations are defined by EPA as operations where animals have been, or will be stabled and fed or maintained for a total of 45 days or more in any 12 month period and where vegetation is not sustained in the conferment area during the normal growing season. CAFOs or Concentrated Anmal Feeding Operations are essentially large AFOs exceeding a numerical threshold set by regulation. See Section 3.0 in http://www.epa.gov/npdes/pubs/cafo_permit_guidance_chapters.pdf.

[5] Research Triangle Institute, 2003. “Benefits of Adopting Environmentally Superior Technologies in North Carolina,” available at http://www.cals.ncsu.edu/waste_mgt/smithfield_projects/phase1report04/appendix%20c-RTI.pdf.

[6] Schiffman, S.S, Studwell, C.E., Landerman, L.R., Berman, K, Sundy, J.S., 2005. Symptomatic effects of exposure to dilute air samples from swine confinement atmosphere on healthy human subjects. Environmental.Health Perspectives, v.113:567-576.

[7] Schiffman, S.S, Sattely Miller, EA, Suggs, M.S., Graham, B.G., 1995. The effect of environmental odors emanating from commercial swine operations on the mood of nearby residents. Brain Research Bulletin, v.4:369-375.

[8] McBride, A. D., 1998. The Association of Health Effects With Exposure to Odors from Hog Farm Operations. Report from the North Carolina Department of Health and Human Services, State Health Director, available at http://www.epi.state.nc.us/epi/mera/iloodoreffects.html.

[9] Avery, R.C., Wing, S., Marshall, S.W., Schiffman, S.S., 2004. Odor from industrial hog farming operations and mucosal immune function in neighbors. Archives of Environmental Health,v.59: 101-108.

[10] Thu, K.U., 2004. Neighbor health and large-scale swine production. National Ag Safety Database Review, available at http://www.cdc.gov/nasd/docs/d001701-d001800/d001764/d001764.html.

[11] Wing, S. and S. Wolf, 2000. Intensive Livestock Operations, Health, and Quality of Life Among Eastern North Carolina Residents. Envr. Health Perspectives, v. 108(3):233-238.

[12] Thu, K., K. Donham, R. Ziegenhorn, S. Reynolds, P. Thorne, P. Subramanian, P. Whitten, and J. Stookesberry, 1997. A control study of the physical and mental health of residents living near a large-scale swine operation. Journal of Agricultural Safety and Health, v. 3(1): 13-26.

[13] National Research Council. 2003. Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs. Ad Hoc Committee on Air Emissions from Animal Feeding Operations, Committee on Animal Nutrition, National Research Council ISBN: 978-0-309-08705-6. Pages 66 - 68

[14] US Environmental Protection Agency (EPA). 2003. Toxicological Review of Hydrogen Sulfide (CAS No. 7783-06-4) In Support of Summary Information on the Integrated Risk Information System (IRIS), June 2003, U.S. Environmental Protection Agency Washington, DCEPA/635/R-03/005 www.epa.gov/iris

[15] Hannah RS, Roth SH. 1991. Chronic exposure to low concentrations of hydrogen sulfide produces abnormal growth in developing Purkinje cells. Neurosci. Lett. 122: 225-228.

[16] Brat I. 2007. A Gas Under Pressure: Health Concerns May Spur Hydrogen Sulfide Ruling; Move 'Costly' for Industry. Wall Street Journal, December 11, 2007; Page B1.

[17] Gilchrist, M.J., Greko, C., Wallinga, D.B., Beran, G.W., Riley, D.G., Thorne, P.S., 2006. The potential of CAFOs in infectious disease epidemics and antibiotic resistance. Envr. Health Perspectives, available at http://www.ehponline.org/members/2006/8837/8837.pdf.

[18] Florini, K., Denison, R., Stiffler, T., et al., 2005. Resistant Bugs and Antibiotic Drugs: State and County Estimates of Antibiotics in Animal Feed and Animal Waste, available at http://www.environmentaldefense.org/documents/4301_AgEstimates.pdf.

[19] Cui, S., Ge, B., Zheng, J., Meng, J., 2005. Prevalence and antimicrobial resistance of Campylobacter spp. and Salmonella serovars in organic chickens from Maryland retail stores. Applied and Envr Microbiology, v.71: 4108-4111.

20 Price, L.B., Johnson, E., Vailes, R. Silbergeld, E., 2005. Fluorquinolone-resistant Campylobacter isolates from conventional and antibiotic-free chicken products.

21 Hamscher, G., Pawelzick, H.T., Sczesny, S., Nau, H., Hartung, J., 2003. Antibiotics in dust originating from a hog fattening farm: a new source of health hazard for farmers? Envr. Health Perspectives, v. 111:1590-1594.

22 Chapin, A., Ruke, A., Gibson, K., Buckley, T., Schwab, K., 2005. Airborne multidrug-resistant bacteria isolated from a concentrated swine feeding operation. Envr. Health Perspectives, v. 113:137- 142.

23 Dosman, J.A., Lawson, J.A., Kirychuk, S.P., Cormier, Y., Biem, J., Koehncke, N., 2004. Occupational asthma in newly employed workers in intensive swine confinement facilities. European Respiratory Journal, v. 24:698-702, available at http://erj.ersjournals.com/cgi/content/full/24/4/698.

24 Merchant, J.A., Naleway, A.L., Svendsen, E.R., Kelly, K.M., Burmeister, L.F., Stromquist, A.M., Taylor, C.D., Thorne, P.S., Reynolds, S.J., Snaderson, W.T., Chrischilles, E.A., 2005. Asthma and Farm Exposure in a cohort of rural Iowa children. Envr Health Perspectives, v. 113:350-356, available at http://www.ehponline.org/members/2004/7240/7240.pdf.

25 Chrischilles, E., Ahrens, R., Kuehl, A., Kelly, K., Thorne, P., Burmeister, L., 2004. Journal Allergy Clin. Immunol, v. 113:66-71.

26 Mirabelli, M.C., Wing, S. Marshall, S.W., Wilcosky, T.C. 2006. Asthma symptoms among adolescents who attend public schools that are located near confined swine feeding operations. Pediatrics, v. 118:66-75.

27 Showers, Bill. Progress Report: Stable Nitrogen Isotopic Tracers of Excess Nitrogen Sources to the Neuse River Basin Estuary and Nearshore Waters, April 1, 1998. NC State University Stable Isotope Laboratory.

28 Rudo, Kenneth. Memo to Dennis McBride, State Health Director, RE: Nitrate Well Water Testing Program Adjacent to Intensive Livestock Operations. August 14, 1998.

29 American Public Health Association. 2003. Policy Statements. http://www.apha.org/legislative/policy/2003/2003-007.pdf

30 A CAFO (concentrated animal feeding operation) is a large AFO (Animal Feeding Operation) See endnote 4. Most of North Carolina's hogs are grown in CAFOs.

31 Donham, K.J., Wing, S., Osterberg, D., Flora, J.L., Hodne, C., Thu, K.M., Thorne, P.S. 2006. Community health and socioeconomic issues surrounding CAFOs. Environmental Health Perspectives. http://www.ehponline.org/members/2006/8836/8836.pdf.