IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex rel, W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA, and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	)	
Plaintiff,	)	CASE NO. 05-CV-329-GKF- SAJ
V.	)	
TYSON FOODS, TYSON POULTRY, INC., TYSON CHICKEN, INC., COBB-VANTRESS, INC., AVIAGEN, INC., CAL-MAINE FOODS, INC., CAL-MAINE FARMS, INC., CARGILL, INC., CARGILL TURKEY PRODUCTS, LLC, GEORGE'S, INC., GEORGE'S FARMS, INC., PETERSON FARMS, INC., SIMMONS FOODS, INC. AND WILLOWBROOK FOODS, INC.	)	
Defendants.	)	

REPORT OF DR. C. ROBERT TAYLOR

1. I am the Alfa Eminent Scholar and Professor of Agricultural Economics at Auburn University, Auburn, AL. This position is equivalent to the rank of Distinguished University Professor. I hold a B.S. degree in agricultural economics from Oklahoma State University, a M.S. degree in economics and agricultural economics from Kansas State University, and a Ph.D. degree in agricultural economics from the University of Missouri-Columbia. I have held tenured positions at the University of Illinois, Montana State University and Texas A&M University in addition to Auburn University. I served on the Executive Board and Foundation Board of the American Agricultural Economics Association, which is the national association for agricultural economists, from 1998-2001. I have served on the editorial board of four scholarly journals, including the American Journal of Agricultural Economics, which is the premier journal in my profession. I am co-author of one graduate textbook book,

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editor of one book, co-editor of three books, and I have authored about one hundred peer reviewed scholarly articles, plus an additional hundred reports, book chapters and other publications.

2. I have conducted economic analyses for the United States Department of Agriculture, the United States Environmental Protection Agency, the United States Department of Energy, the National Science Foundation, the Natural Resources Economics Service, the United States Army Corps of Engineers, the United States Forest Service, the American Farm Bureau Research Foundation, Ciba-Geigy company, the United States Congressional Office of Technology Assessment, the National Crop Insurance Service, various state agencies, and state agricultural organizations. I have also given "briefings" on price, income and consumer effects of pesticide policy to the United States Senate and House Agriculture Committees, to the United States Environmental Protection Agency, to a national agricultural industry group, and to the Chief Economist of the United States Department of Agriculture.

3. I have testified to the United States Senate Committee on Agriculture, Nutrition and Forestry in a session on Economic Concentration in Agribusiness in 1999, and I provided testimony for the United States House Agricultural Committee Hearings on Livestock Prices. I also testified to the United States Senate Committee on Agriculture, Nutrition and Forestry in 2002, in a session on banning packer ownership of cattle and hogs, and on USDA/GIPSA's enforcement of the Packers and Stockyards Act. In April of 2007, I testified to the United States House of Representatives Committee on Agriculture, Subcommittee on Livestock, Dairy and Poultry on key issues affecting the livestock and poultry industries.

4. In 2002, I gave an invited talk to the Oklahoma Senate titled "The Global Food System: Legal Issues from an Economist's Perspective." I also gave a talk in 2002 on "Contract Agriculture: Legal Issues from an Economist's Perspective," at a CLE conference sponsored by the Oklahoma Attorney General's Office and the Oklahoma Bar Association.

5. Early in my professional career I conducted substantive research on plant nutrients as water pollutants. More recently, I have done extensive work regarding the economics of the livestock and poultry industries, including analyses of market power imbalances.

6. I have been retained by the State of Oklahoma to evaluate the relationship between poultry growers and defendant poultry companies, and to assess the economics of the poultry industry, including removal of poultry waste from the Illinois River Watershed (IRW). My fees in this litigation are $150/hour for research and $300/hour for testimony.

7. The domestic poultry meat industry is fully integrated vertically[1], meaning that ownership and control of essentially all aspects of production in the vertical chain from baby chick to processed broilers and wholesale poultry products is held by poultry companies, commonly known as "integrators." [2] The poultry industry, which includes broiler, turkey and egg production, is the most vertically integrated of all major agricultural industries.[3] Each of the defendant companies is vertically integrated, and each has the business practices discussed below.

8. Integrators generally own or control the breeding flock, hatcheries, chicks, assignment of baby chicks to growers, feedmills, feed ingredients, transportation of feed, and processing (slaughter) plants. Integrators make all decisions regarding placement of baby chicks, the number of chicks placed with each grower, and when birds ready for processing will be picked up from the grower. Integrators also dictate specifications for growout house and equipment. Location of growout facilities and thus location of poultry waste generation is also fully controlled by the integrators.

9. Under the dominant business arrangement, the integrator owns the chicks and feed, while farmers, commonly called contract growers, carry out actual production, or growout, from chicks to birds ready for processing.[4] Growout of each flock is under the direct supervision and control of the integrator. Integrator representatives (service technicians) typically visit each growout house at least weekly to check on and supervise the grower's care of flocks and check on litter, waste and dead birds.[5] Integrator representatives also give instructions or directives to growers regarding maintenance and upgrades of facilities. Many of these obligations are found in standardized contracts integrators provide to growers. Molnar, et al, state, "*This*

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[1] A report by the Economic Research Service (ERS) of USDA defines vertical integration as a "method of vertical coordination representing the greatest degree of control that a firm can gain over another stage of production. Coordination of two or more stages occurs under common ownership via management directive." Steven W. Martinez, Vertical Coordination in the Pork and Broiler Industries: Implications for Pork and Chicken Products. USDA/ERS Agricultural Economic Report No. 777, April 1999, p. iv. Clement Ward, in an Oklahoma State University Extension report defines vertical integration as "where one firm owns and controls a commodity and the products processed from it through the entire producer-to-consumer supply chain. In this case, the integrating firm decides what, how, and how much to produce and process to meet consumer demands." Beef, Pork and Poultry Industry Coordination, Bulletin F-552, Dec. 2004.

[2] The industry is self-described by the National Chicken Council as "vertically integrated." http://www.nationalchickencouncil.com/aboutIndustry/detail.cfm?id=15

[3] Development and extent of contracting with various crops and types of livestock is given in James M. MacDonald and Penni Korb, Agricultural Contracting Update: Contracts in 2003, USDA/ERS Economic Information Bulletin No. 9, Jan. 2006.

[4] See, for example, Tomislav Vukina, "Vertical Integration and Contracting in the U.S. Poultry Sector," Journal of Food Distribution Research, July 2001:29-38.

[5] Weekly visits by service technicians are confirmed by deposition testimony. See, for example, deposition of Patrick Pilkington, August 20, 2007, 50:12-18; deposition of Benny McClure, August 15, 2007, 137: 9-16; and deposition of Leesa Butler, August 22, 2007, 22:17-19, 16:8-15, and 36:13-17. See also, Dan L. Cunningham, Guide for Prospective Contract Broiler Producers, University of Georgia College of Agriculture and Environmental Sciences, Bulletin 1167, Revised May 2008, p. 3.

network of company specialists [i.e. service technicians] comprises the command-and-control structure that specifies the grower's production process."[6]

10. Integrators require growers to provide expensive specialized production facilities (houses, associated equipment, utilities), grower services (labor and management), and waste management and disposal.

11. Beginning in the 1950s contracting of broiler production evolved from simple credit arrangements with feed companies, to profit-sharing arrangements, to flat fee contracts, and finally to a basic feed-conversion contract.[7] Almost all broiler and turkey contracts now establish a base fee the grower will receive, with a plus or minus adjustment based on relative performance compared to other growers for the same integrator in the same complex. Economists often refer to this arrangement as a pay "tournament." Some poultry contracts, such as for breeders, pullets, and layers have a performance based (bonus) system, but do not rank growers against each other as in a tournament.

12. Open, transparent cash markets for broilers or turkeys ready for processing disappeared decades ago.[8] Because there is no open market for poultry ready for processing, there is no economically viable alternative for commercial, non-specialty growers who wish to be independent from integrators. Integrators will not purchase birds from truly independent growers. Therefore, a person cannot independently raise commercial poultry and have a ready cash market for them.

13. In April 2008 the Pew Commission published a comprehensive report on industrial farm animal production. This project was funded by a grant from The Pew Charitable Trusts to the Johns Hopkins Bloomberg School of Public Health to investigate the problems associated with industrial farm animal production, including poultry. This Commission succinctly described the poultry industry and waste problems, *"Most broiler chickens raised in the United States are produced under contract arrangements with integrated poultry producing companies. These companies typically control almost every aspect of production—they own the breeder flocks, hatcheries, chickens, feed mills, processing plants, and marketing agreements. Contract growers produce the chickens from hatchings to marketable size in broiler houses using equipment that meets the specifications of the integrator. The producer owns or leases the land and the facilities to raise the broilers, and the integrator owns the chickens and feed. Growers are also responsible for management of the litter as well as for the taxes, utilities, and insurance. The amount of litter produced annually for a broiler facility can be substantial; for example, a broiler farm that has*

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[6] J. J. Molnar, T. Hoban and G. Brant, "Passing the Cluck, Dodging Pullets: Corporate Power, Environmental Responsibility, and the Contract Poultry Grower," Southern Rural Sociology, Vol. 18 (2), 2002, pp88-110.

[7] Vukina further discusses evolution of the poultry industry. See *supra* note 4. The lack of bargaining power is also discussed by Daryll E. Ray, "On Compensating Producers Who Contract Production," Article Number 233, Agricultural Policy Analysis Center, University of Tennessee, 2005.

[8] Although there is no open, transparent market for birds ready for processing, there are special deals allowing executives and insiders of some integrators to sell birds ready for processing to the integrator.

four houses (each containing between 28,000 and 30,000 chickens) and that markets 4-pound broilers could generate approximately 340 tons of manure per year."[9]

14. In the early history of the vertically integrated poultry industry, the integrators and growers were partners and tended to look out for each other's economic welfare. Vukina and Leegomonchai, state, *"Production contracts have played a decisive role in the broiler industry's remarkable growth but the integrator-grower relations have gradually worsened. Starting in the mid 1990s the tensions have received increasing attention nationwide."* [10] The industry has evolved to the point that growers are completely at the mercy of their integrator. In economics, this is referred to as monopsony, or "buyer" or "contractor" power held by the integrator over their growers.

15. New growers are not permitted to negotiate contract terms with integrators; the only option given by an integrator to a grower is to accept or reject the contract.[11] Vukina and Leegomonchai, state, *"Modern broiler contracts are written by the integrator and offered to prospective growers on a **take-it-or-leave-it** basis."*[12] Moreover, the integrator solely determines when a new contract is adopted and all terms of that contract. Because of the long economic life of highly specialized poultry growout facilities, the business options facing an existing grower are often (a) bankruptcy, or (b) acceptance of whatever contract changes are dictated by the integrator. Arms-length contract negotiations rarely if ever occur between grower and integrator; rather, contracts of adhesion characterize the industry. [13]

16. Integrators often assert that the Packers & Stockyards Act (PSA) requires them to have the same contract for all growers. In my opinion, poultry integrators often use such PSA assertions as a pretext to maintain complete contractual control over growers.

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[9] Putting Meat on the Table: Industrial Farm Animal Production in America, a Report of the Pew Commission on Industrial Farm Animal Production, The Pew Charitable Trusts and Johns Hopkins Bloomberg School of Public Health, April 29, 2008, p. 42.

[10] Tomislav Vukina and Porametr Leegomonchai, "Political Economy of Regulation of Broiler Contracts," American Journal of Agricultural Economics 88, December 2006, 1258-1265.

[11] Patrick Pilkington testified at the preliminary injunction hearing in this case that Tyson contracts were non-negotiable. PI Transcript, March 3, 2008:1465:22-25. Deposition statements of representatives of defendant integrators also generally establish that growers are not permitted to negotiate contracts or contract changes. See, Leasea Butler, deposition of 8/22/2007 at 12:16 through 13:13; Benny McClure, deposition of 8/15/2007 at 132:24 through 133:10; Gary Murphy deposition of 7/30/2007 at 230: 6-12; Ray Wear deposition of 7/26/2007 at 56:14 through 57:14; and Patrick Pilkington deposition of 8/20/2007 at 20:6 through 21:12. A certified mail letter dated 1/31/1994 from Julian Wallace, Live Production Manager, Tyson Foods, Inc. to Mr. Norman Ranger, Idabel, OK, states, "Our available contract, as you well know, is non-negotiable ..."

[12] Tomislav Vukina and Porametr Leegomonchai, "Political Economy of Regulation of Broiler Contracts," American Journal of Agricultural Economics 88, December 2006, 1258-1265. Bold emphasis added.

[13] My translation of the legal concept of a contract of adhesion is that it means there is a such an imbalance of economic power that the only viable option one side (in this case the grower) to the transaction has is to accept or reject what is offered by the other side (integrator).

17. Integrators PSA assertions are belied by the fact than many integrators have different contracts for different complexes, even adjacent complexes, bounds of which integrators define without any reference to the PSA. A grower in one complex may have production facilities in close proximity to another grower for the same integrator but have a different contract, only because the two growers' production facilities are in different complexes.

18. Gary Murphy, representing defendant Simmons Foods, claimed that no negotiations occurred with growers because *"Packers and Stockyards pretty well dictates that we have to treat all growers the same."*[14]It is not clear whether he was referring to the Packers and Stockyards agency (now GIPSA), or to the PSA law itself; certainly USDA/GIPSA does not have the authority to make such a dictate because when Congress added poultry to the PSA in 1987 they failed to give USDA authority to enforce Section 202 of the Act.

19. Patrick Pilkington, representing defendant Tyson Foods, said, *"it's my understanding that we have an obligation through Packers and Stockyards regulations to treat similarly situated growers similarly."*[15] Yet, Pilkington's assertion is contradicted by growout deals Tyson executives and insiders had for many years. Security and Exchange (SEC) documents show that Tyson executives and insiders have had substantially different deals that allowed them to buy chicks, feed and medication, have the birds apparently grown by unspecified contract growers, then sold back to Tyson or to unrelated parties. SEC documents show that in the aggregate these insider deals accounted for millions of dollars annually.[16] Obviously this is a substantially different growout arrangement than what Tyson offered to contract growers.

20. The integrators PSA assertion is also belied by Peterson's grower contracts (e.g. PFIRWP-000819 – PFIRWP-000820) that show the key flock cost parameter (often called the prime cost or median cost) used to compute tournament pay for individual flocks differs for insiders than for other growers. Thus, pay for an insider's flock may differ from pay for a contract grower, even if the flocks had identical performance (individual flock cost for the settlement week).

21. The PSA also applies to hogs and cattle, yet there are a wide variety of contractual relationships existing in each of these industries. In fact, Tyson has historically had several types of contracts for obtaining slaughter cattle, even those coming from the same area or the same feedlot. Therefore, poultry integrators' common assertion that the PSA prevents them from negotiating with individual growers is pretext, in my opinion.

22. Lack of options for a grower is apparent from a 2004 national survey of growers reported by USDA/ERS in April 2008. This report states, *"Fifty-nine percent of growers with broiler production contracts responded that they had no marketing*

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[14] Gary Murphy, deposition of July 30, 2007: at 136:2-5.
[15] Patrick Pilkington, deposition of August 20, 2007 at 21:3-12.
[16] See, for example, Tyson's Security and Exchange Commission (SEC) form DEF 14A filed 12/31/2003.

option other than their current integrator ... A quarter of contract broiler operations had only a single integrator in the area, while another 29 percent reported two integrators and 22 percent reported three. A given integrator may not be taking on new growers, and as a result it is quite possible for a grower to report that there are two or three companies in the area, but still report that he/she has no alternatives to his/her present contractor. ... Contract growers make significant long-term investments in housing. ***One of the striking features of production contracts is that, although growers and integrators typically have long-term relationships, contracts are usually written for short durations.*** *... Growers and integrators maintain long-term relationships with short-term contracts by renewing contracts annually. Contract renewal, however, often requires a significant new capital investment by growers."*[17] MacDonald and Korb, economists with ERS/USDA, state, *"Once the investment is made, growers face the risk of opportunistic behavior by integrators, who may have considerable monopsony power at that point. ... With a short-term contract, integrators may adjust payment schemes, or hold up growers for additional investments, as a condition of renewal."*[18] The 2008 Pew Commission report on Industrialized Farm Animal Production emphasizes the limited choices grower have, *"Once the commitment is made to such capital investment, many farmers have no choice but to continue to produce until the loan is paid off. Such contracts make access to open and competitive markets nearly impossible for most ... poultry producers, who must contract with integrators if they are to sell their product."*[19] These industry characteristics are manifestations of the control poultry integrators have over growers nationally and in the IRW. Even though there are several integrators in the IRW, defendant integrators maintain monopsony or oligopsony power over their contract growers, extending to waste and dead bird disposal.

23. A national survey of poultry producers conducted by Purdue University in 1999 for Farmers Legal Action Group (FLAG) with USDA funding reported that survey respondents had been growing broilers an average of 16 years.[20]

24. Poultry grow-out operations have a very long economic payout period, typically 20-30 years for a wood frame house and longer for a metal frame house.[21]

25. Broiler production is both capital and labor intensive.[22] Growers bring roughly one-half of the capital and much of the labor required to produce a processed whole bird.

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[17] James MacDonald and Penni Korb, Agricultural Contracting Update, 2005, USDA, Economic Research Service, Economic Information Bulletin Number 35, April 2008. Bold emphasis added.
[18] *Ibid, pp 12-13.*
[19] Putting Meat on the Table: Industrial Farm Animal Production in America, a Report of the Pew Commission on Industrial Farm Animal Production, The Pew Charitable Trusts and Johns Hopkins Bloomberg School of Public Health, April 29, 2008, p. 49.
[20] Farmers Legal Action Group, Assessing the Impact of Integrator Practices on Contract Poultry Growers, September 2001, p. 2.3.
[21] See. For example, Cunningham who states that poultry houses represent long-term investments of 30 years or more. Dan L. Cunningham, Cash Flow Estimates for Contract Broiler Poroduction in Georgia: A 20-Year Analysis, University of Georgia College of Agriculture and Environmental Sciences, Cooperative Extension Service, Bulletin 1228, March 2003.

26. Four to six houses generally constitute a full time job for one person. The average size of a grower's operation in the IRW is approximately 3 to 4 houses. Such an operation now costs between $500,000 and $1,000,000 to construct, depending on size and equipment. A 2006 Oklahoma State University broiler budget shows a single house and equipment costing $255,000.[23]

27. Long-term profitability for growers has been declining. A 1992 Oklahoma State University (OSU) study reports a negative budgeted return (loss) of $953 annually (on a $100,000 investment) to risk, management, land, and overhead after subtracting a modest charge of $4.50/hour for family labor.[24] A similar OSU budget published in 2006 reports shows a larger loss of $4,260 annually (on a $255,000 investment).[25] Translated from economic jargon, these OSU studies show that growers are getting a sub-competitive return for labor, and nothing for bearing substantial risks due to the integrators control of future pay, flock placements, and many other factors influencing profitability. In a sense, poultry contracts cash flow (i.e. put money in the growers pockets), but the contract pay has not generally been sufficient for growers to earn a competitive return in recent years.

28. Shofner reports a 1999 survey of Arkansas poultry growers conducted by the University of Arkansas on behalf of the Arkansas Farm Bureau Association (AFBA). She reports that the survey revealed *" ... 67% (of respondents) stated that they are not getting a fair return on their investment."* Shofner also states, *"As it becomes apparent that income from the poultry operations is not sufficient, many producers are finding it necessary to have off-farm income just to make ends meet. Over 47% of respondents of the AFBA survey revealed that their spouse had either part-time or full-time off-farm employment. There simply may not be adequate net income from the poultry operations only to support a household. This is particularly the case if substantial debt service on the operation exists."*[26]

29. Although there is a long economic payout period of 20-30 years for poultry growout facilities, poultry contracts are typically for a much shorter time period. Defendants' contracts with growers have been generally for one year or less (See summary of defendant's contracts in Appendix B). A flock-to-flock contract has predominated in the IRW for the past two decades. Some recent contracts cover longer time periods, but there is no wording in these contracts that requires the defendant to provide more

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[22] Vukina notes, "The poultry industry is predominately organized in a manner that limits capital requirements by the integrator." *Supra* note 4.
[23] Damona Doye, Brian Freking and Joshua Payne, Broiler Productin: Considerations for Potential Growers, Oklahoma Cooperative Extension Fact Sheet, F-202, March 2006.
[24] Damona G. Doye, Joe G. Berry, Parman R. Green, and Patricia E. Norris, Broiler Production: Considerations for Potential Growers, Oklahoma Cooperative Extension Fact Sheet, F-202, November 1992.
[25] Damona Doye, Brian Freking and Joshua Payne, Broiler Productin: Considerations for Potential Growers, Oklahoma Cooperative Extension Fact Sheet, F-202, March 2006.
[26] Tara Shofner, "Development of the Interactive Broiler Income Spreadsheet," American Journal of Agricultural Economics 82 (Dec. 2000): 1240-1246.

than one flock. For example, Tyson's 2005 contract covers three years (TSN107938SOK – TSN107939SOK), and Simmon's 2006 addendum covers seven years, but there is no wording in these contracts requiring either defendant to provide birds in a continuous, timely way necessary for the grower's economic survival over the stated multi-year time period.

30. A USDA survey of poultry growers in 2001 revealed that 35% of contracts were for less than three months, and only 16% of contracts were for longer than one year.[27] A USDA survey showed that the median length of broiler contracts was 12 months in 2004, which is consistent with the length of most contracts in the IRW.[28]

31. Integrators typically mandate specifications for poultry houses and equipment, and often require growers to make investments in upgrading equipment or facilities. A 2001 USDA national survey reveals that 84% of contract poultry growers were "... *required to make investments in equipment or facilities.*"[29] A USDA survey update revealed that 49% of broiler growers were required to make capital investments in 2004, and that this investment in the single year averaged $49,037 per grower. Survey results imply that the average respondent had 3-4 standard size houses, so the average investment in the single year averaged $10,000-15,000 per house for about one-half of the growers.

32. New growers typically borrow all funds for construction of houses and equipment, offering a small acreage of land as collateral. Mandated house and equipment upgrades can send growers back to the start of their debt challenge.[30] The on-going debt challenge often puts growers at the mercy of any changes in contract terms desired by the integrator. Growers rarely have any viable economic option other than accepting contract changes dictated by the integrator.

33. Farmers become contract growers only with approval of an integrator. Similarly, existing growers who wish to expand production by building additional houses do so only with the integrators express permission.

34. Once waste is removed from the poultry house it no longer has a role in the defendants' poultry production process.

35. Once a person becomes a grower, the integrator has almost total economic control and determines profitability or lack thereof of the average grow-out operation. Thus, the integrator effectively makes the decisions that determine whether growers have sufficient resources to properly manage and dispose of waste produced by the integrator's birds.

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[27] http://www.ers.usda.gov/Briefing/FarmStructure/Questions/livestock.htm

[28] James MacDonald and Penni Korb, Agricultural Contracting Update, 2005, USDA, Economic Research Service, Economic Information Bulletin Number 35, April 2008.

[29] http://www.ers.usda.gov/Briefing/FarmStructure/Questions/livestock.htm

[30] Mark Jenner, Understanding the Lender's Share of Grower Contract Pay, American Farm Bureau Federation, January 3, 2002.

36. Integrators make the decisions about the location of grow-out facilities. Integrator control over location of production facilities is so complete that individuals desiring to become growers who are outside an area defined by an integrator—typically 25-50 miles--are simply not offered the option to become a grower.

37. In my opinion, defendants' desire to minimize feed and bird transportation costs is the economic driving force behind their concentration of growers and thus waste generation in the IRW. A statistical analysis of survey responses by Sambidi, et al, identifies location of the feedmill serving the complex to be the top indicator of location of grow-out facilities, a conclusion based on survey responses by chief executive officers within the broiler industry.[31] Vukina and Leegomonchai state, *"Contract growers are typically located within a short distance from the integrator's processing plant because live birds cannot be hauled long distances. Broiler operations also tend to be concentrated in the proximity of feedmills such that integrator's costs of distributing feed to contract producers are minimized. These characteristics are very important because they restrict the grower's choice of integrators."* [32] MacDonald and Korb also point to feed and bird hauling costs, "... *transportation costs (including the mortality risk to chicks and broilers from truck transport) make for local markets in live poultry, greatly reducing the number of potential buyers."*[33]

38. Many integrators even specify a maximum allowable distance between a broiler farm and the feed mill. For example, a Tyson web page, which was recently removed, stated, *"Normally the (grower) farms are required to be within thirty to forty miles of the feedmill in the complex."* [34] Kirk Houtchens, representing Peterson Farms, stated that distance was an important factor in locating growers; he also stated that 50 miles from a feedmill was about the maximum distance for a grower.[35] Defendants' desire to minimize their out-of-pocket feed and bird hauling costs therefore concentrate waste products in a small geographical area. Integrators, not growers, therefore directly determine where waste products are generated in the IRW.

39. Agricultural statistics indicate that feed grain (e.g. corn) and high protein crop (e.g. soybeans) production is practically non-existent in the IRW. Phosphorus contained in the feedstuffs, and that added to poultry feed, thus constitute the major source of phosphorus imported into the IRW.

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[31] P. R. Sambidi, R. W. Harrison, and A. J. Farr, A Conjoint Analysis of Site Selection for the U.S. Broiler Industry: Implications for Louisiana, Lousiana State University Ag Research and Extension Center Bulletin No. 882, August 2004.

[32] T. Vukina and P. Leegomonchai, "Oligopsony Power, Asset Specificity and Hold-Up: Evidence from the Broiler Industry," American Journal of Agricultural Economics, Vol. 88 (December 2006): 1258-1265.

[33] James M. MacDonald and Penni Korb, "The Growing Use of Contracts to Govern US Farm Production, Paper presented at the 2006 Annual Conference of the International Society for New Institutional Economics, Boulder, CO, September 23, 2006, p. 12.

[34] http://www.tysonfoodsinc.com/corporate/info/growersFAQ.asp downloaded on 8/10/2005.

[35] Deposition of Kirk Houtchens, July 26, 2007, 28:18 through 30:18.

40. The fact that multiple integrators chose to locate in the same area, particularly the IRW, further concentrates and exacerbates pollution, health and other environmental problems caused by poultry waste. An April 2008 report by the Union of Concerned Scientists states, *"The problems that arise from excessive size and density (e.g. air and water pollution from manure, overuse of antibiotics) are exacerbated by the parallel trend of geographic concentration, whereby CAFOs [confined animal feeding operations] for particular types of livestock have become concentrated in certain parts of the country. For example ... broiler chicken CAFOs in Arkansas and Georgia."*[36] They also state, *"Manure from CAFOs is a major source of water pollution because these operations produce too much manure in too small an area, and this manure is rarely treated to eliminate potentially harmful components before being applied to crop fields or stored in facilities such as lagoons or pits (EPA 2003)"*[37]

41. An integrator's decisions about where to locate a complex and the size of the area in which growout facilities (and thus waste production) is typically based on its out-of-pocket expenses for hauling feed to growout facilities and birds to processing plants. The business model adopted by defendants ignores external (pollution and health) costs associated with poultry waste and thus results in waste generation and land application of waste being concentrated in relatively small geographical areas. Watershed pollution problems in the aggregate are therefore determined not by an individual farmer's growout operations, but by defendant's individual and collective decisions to concentrate poultry production and thus waste generation in relatively small geographic areas. As stated in a University of Arkansas Extension Bulletin, *"The real issue is not the P concentration in runoff from the edge of any one field, but the total P load that is transported to the stream or lake from an entire watershed."*[38]

42. In my opinion integrators, including defendants, have used their economic control over growers to attempt to shift environmental costs and health risk costs from themselves to growers. Molnar, et al, summarize this attempted risk shifting, *"Broiler production is concentrated in a few southern states where farmers are highly dependent on contract arrangements for income and livelihood. ... Asymmetrical power relationships shift waste management responsibilities to growers in a number of ways. This paper details maneuvers poultry integrators use to avoid environmental risk and transfer it to their contract growers. Corporations 'pass the cluck' when they shift responsibility for achieving regulatory compliance to the farmer who then must seek technical and financial assistance from public agencies. Poultry integrators*

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[36] Doug Gurian-Sherman, CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations, Union of Concerned Scientists, April 2008, p. 2.
[37] *Ibid.*, p. 42.
[38] Mike Daniels, Tommy Daniel and Karl VanDevender, Soil Phosphorus Levels: Concerns and Recommendations, University of Arkansas Division of Agriculture, Cooperative Extension Service, Bulletin FSA1029-500-3-04R, 1999 and 2004

'dodge pullets' when they retain ownership of live animals, but dead birds become the farmer's property and disposal problem." [39]

43. A Pew Commission report, published in 2008, notes the integrators shifting of risks and external costs to growers, *"Under the modern-day contracts between integrators and growers, the latter are usually responsible for disposition of the animal waste and the carcasses of animals that die before shipment to the processor. The costs of pollution and waste management are also the grower's responsibility. ... Because the integrators are few in number and control much if not all of the market, the grower often has little market power and may not be able to demand a price high enough to cover the costs of waste disposal and environmental degradation. These environmental costs are thereby 'externalized' to the general society and are not captured in the costs of production nor reflected in the retail price of the product."*[40] The 2008 report on CAFOs by the Union of Concerned Scientists discusses at length the external costs of excess manure being borne by society rather than integrators.[41] Defendants' shifting of environmental risks to growers and society at large is evident in the IRW.

44. Poultry contracts in the IRW generally show an increasing effort by defendants' to explicitly shift to contract growers the environmental costs and health risk costs associated with poultry waste generated from defendant's birds, feed, and medicine.

45. Early grower contracts made no mention of used litter and waste disposal responsibilities. However, since the early 1990s, defendants' contracts typically state that the grower is responsible for meeting all applicable state, federal, and local environmental laws and regulations. Examples of the evolution of defendant's contracts with specific reference to used litter and waste follow.

    a. Defendant Cargill's turkey contract in 1981 did not mention responsibility for, or disposal of, used litter and waste, except for the grower's responsibility to dispose of dead birds (CARTP133037 – CARTP133047). Cargill's 1990 contract, however, stated, *"Grower agrees to comply with all applicable state, county, local and federal **health** laws."* (CARTP135792 – CARTP135796). Cargill's 1993 contract expanded wording in the 1990 contract to state *"Grower aggress to comply with all applicable state, local, and federal laws and requirements, including but not limited to **health and environmental** regulations."*[42] (CARTP002257

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[39] J. J. Molnar, T. Hoban and G. Brant, "Passing the Cluck, Dodging Pullets: Corporate Power, Environmental Responsibility, and the Contract Poultry Grower," Southern Rural Sociology, Vol. 18 (2), 2002, pp88-110.

[40] Putting Meat on the Table: Industrial Farm Animal Production in America, a Report of the Pew Commission on Industrial Farm Animal Production, The Pew Charitable Trusts and Johns Hopkins Bloomberg School of Public Health, April 29, 2008, p. 6.

[41] Doug Gurian-Sherman, CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations, Union of Concerned Scientists, April 2008. Chapter 3, in particular, discusses the externalized costs of CAFOs.

[42] Bold emphasis added.

– CARTP002260). Cargill's 2005 contract also required the grower to have an approved Nutrient Management Plan that complied with all applicable federal, state, and local laws and regulations and complied with best management and agronomic practices in the region (CARTP007134 – CARTP007141).

b. Defendant Tyson's 1986 broiler contract did not specifically mention disposal of used litter and waste, or responsibility for disposal of dead birds (TSN54063SOK – TSN54064SOK). However, Tyson's broiler contract for 1999 states *"The Producer shall be responsible for the removal of all dead birds and litter and shall dispose of dead birds and litter in accordance with the law applicable to this location."* (TSN54238SOK – TSN54239SOK). Tyson's 2006 broiler contract is more specific, *"Producer will comply with all applicable federal, state, and local statutes, rules, regulations, and ordinances in performance of this Contract, including but not limited to all those governing environmental and poultry litter management."* (TSN107938SOK – TSN107939SOK).

c. Defendant George's' 1987 pullet growing contract did not mention responsibility for disposal or ownership of used litter and waste (GE312 – GE315), while their 1993 contract states that the grower will *"Dispose of litter in accordance with Best Management Practices, a copy of which has been provided,*[43] *and to work with Soil Conservation Service in developing a Nutrient Management Plan for his farm, and to follow all regulations pertaining to litter disposal."* (GE241 – GE246). George's' 1997 pullet growing contract has the same wording about litter disposal as the 1993 contract (GE817 – GE822), but has an attachment that gives detailed guidelines for poultry waste management. This attachment (GE823) states that it was *"compiled by Cooperative Committee for Poultry Farm Litter and Waste Disposal, comprised of members of the Arkansas Poultry Federation, Soil Conservation Service, Arkansas Department of Pollution Control and Ecology, Arkansas Extension Service, and Arkansas Soil & Water Conservation Service."* George's' broiler contracts show a similar evolution of assignment of responsibility for used litter and waste to the grower.

d. Defendant Simmons' broiler contracts for 1979 and 1986 make no mention of responsibility for disposal or ownership of used litter and waste (SIM AG 13722 –SIM AG13724, SIM AG 30790 – SIM AG 30793). However, their 1995 broiler contract states that the grower agrees *"To follow the Federal Insecticide, Fungicide and Rodenticide Act, as well as appropriate FDA, USDA, and EPA regulations."* (SIM AG 12633 – SIM AG 12635). The 1997 contract added the requirement that the grower *"dispose of litter in accordance with Best Management Practices*

[43] Such a copy was not attached to the 1993 contract I reviewed.

as detailed by the nutrient management plan for Grower's farm developed with appropriate governmental agencies, and to follow all applicable regulations pertaining to litter disposal." (SIM AG 12388).

e. Defendant Peterson's 2004 broiler contract, like recent Simmons' contracts, states that the Grower agrees, *"To follow Federal Insecticide, Fungicide and Rodenticide Act of 1947, as well as appropriate FDA, USDA, State, and EPA regulations."* (PFIRWP-000835 –PFIRWP-000844). The contract also requires the grower to have and follow a litter management plan, and to provide Peterson with a copy of that plan. Unlike contracts used by other defendant's, the 1999 Peterson contract states, *"All poultry waste produced by the birds covered by this contract shall be the exclusive property of the Contract Farmer and the Contract Farmer shall be responsible for and receive all of the economic benefits from the use and disposal of said waste."* (PFIRWP-0747060 – PFIRWP-0747062) Peterson's 2004 broiler contract has essentially the same wording, *"... the litter shall be the exclusive property of the contract grower and contract grower shall be responsible for and receive all of the economic benefits from the use and disposal of said litter."* (PFIRWP-000838). Peterson's 2005 broiler contract (PFIRWP-000819 – PFIRWP-000829) states that the litter is the exclusive property of the grower, but then goes on to specify exactly how the grower is to dispose of litter and waste he/she presumably owns. Waste disposal practices in Peterson's contract (PFIRWP-000826) are those developed by the Cooperative Committee for Poultry Farm Litter and Waste Disposal, which are also included in Georges recent contracts (e.g. GE823).

f. Defendant Peterson's 1997 Breeder Hen contract makes no mention of responsibility for waste generated by defendant's birds, although it does require the grower to dispose of all dead birds. Defendant Petersons's 2004 Pullet contract requires a litter management plan as required by Peterson Farms **or** federal, state or local law. Unlike contracts used by other defendants, this Peterson contract states, *"all poultry waste produced by the birds covered by this Agreement shall be the exclusive property of the contract farmer and the contract farmer shall be responsible for and receive all of the economic benefits from the use and disposal of said waste."* (PFIRWE0012498 – PFIRWE0012503)

g. The 2003 Cal-Maine Breeder Pullet Brooding and Rearing Agreement does not explicitly mention responsibility for used litter and waste, although it states that the grower must *"... comply with all applicable sta[t]e, local, and federal health laws. In the event that grower shall fail to comply with an[y] provision of the applicable laws, then owner is hereby granted and shall have the right to enter upon the grower's premises and correct and perform such necessary acts so as to comply*

with said laws or regulations and the expenses incurred thereto shall be charged to the grower." (CM-001366 – CM-001368).

h. A 1991 Cal-Maine Egg Production Agreement states that the grower agrees *"To provide all clean up, according to Owner's specifications; and to comply with accepted practices of waste and dead bird disposal. ... To comply with all applicable state, county, local and federal laws; in the event that grower shall fail to comply with any provision of the applicable laws, then owner is hereby granted and shall have the right to enter upon the grower's premises ... and correct and perform such necessary acts so as to comply with said laws or regulations and the expenses incurred thereto shall be charged to the Producer."* (CM-000000338 -- CM-000000343). In contrast, a 1992 Cal-Maine Egg Production Agreement states that *"Producer agrees to be responsible for the proper clean up of Producer's facilities in accordance with generally accepted poultry husbandry practices and to comply with all applicable laws and regulations, including, but not limited to, rules and regulations promulgated by the Environmental Protection Agency and the agency of Producer's state responsible for disposal of waste and emissions, relative to the disposal of any and all waste products produced from Producer's facilities including, but not limited to, waste water run-off, manure and dead birds."* (CM-000000332 – CM-000000333).

i. Cobb-Vantress Breeder Hen contract for 2001 requires the grower *"To clean litter from houses upon completion of bird cycle."* This contract also states *"The Producer agrees to provide poultry disposal equipment and to dispose of all dead birds according to the company's specifications and as required by federal, state and local laws."* Although this contract requires the grower to provide "poultry" disposal equipment, it does not specifically mention responsibility for disposal of waste. (TSN60299SOK -- TSN60302SOK) In contrast, the 2003 Cobb-Vantress Breeder Hen contract states *"The Producer shall be responsible for removing all dead birds and litter and shall dispose of such in accordance with the Company's specifications and applicable laws. ... The Producer agrees to remove all litter and debris from the poultry houses as soon as possible after the completion of the bird cycle."* (TSN60289SOK -- TSN60294SOK) The 2005 Cobb-Vantress Breeder Hen contract adds to the wording in the 2003 contract that *"The Producer agrees to comply with all applicable federal, state, and local statutes, rules, regulations, and ordinances in performance of this contract, including but not limited to all those governing environmental and poultry litter management."* (TSN60277SOK -- TSN60281SOK)

j. Appendix B gives my abbreviated summary of features of defendant's contracts that I have reviewed.

46. Defendant Peterson's Farms shifting of costs to growers of disposing of waste from their birds is evidenced by defendant Peterson's 2003 letter to a grower in the ESW stating "*Beginning October 27, 2003 Peterson Farms will not place chicks on any farm that does not have litter properly stored including de-cake. If producer is unable to remove litter from the premises then Peterson Farms can arrange, at your request, the transport of the litter outside the watershed and will charge the producer for the actual transportation cost. The transportation cost will be taken out of the producer's next settlement check.*"[44]

47. Due to the long economic payback period for poultry production facilities, existing growers often have no option but to accept contract additions, including those pertaining to litter and waste.

48. Complete control over growers' contract terms, and disposition of litter and waste by defendants' Tyson Foods, Cobb-Vantress, Peterson Farms, Simmons Foods, Cargill, and George's is manifested in the defendant' settlement in the City of Tulsa litigation over the ESW.[45]

49. In summary, defendants' fully control who will be a grower, who will be responsible for disposal of waste and dead birds, and all contract terms. Defendants' also fully determine the location of poultry waste generation in the IRW, as well as how much waste is generated in the IRW.

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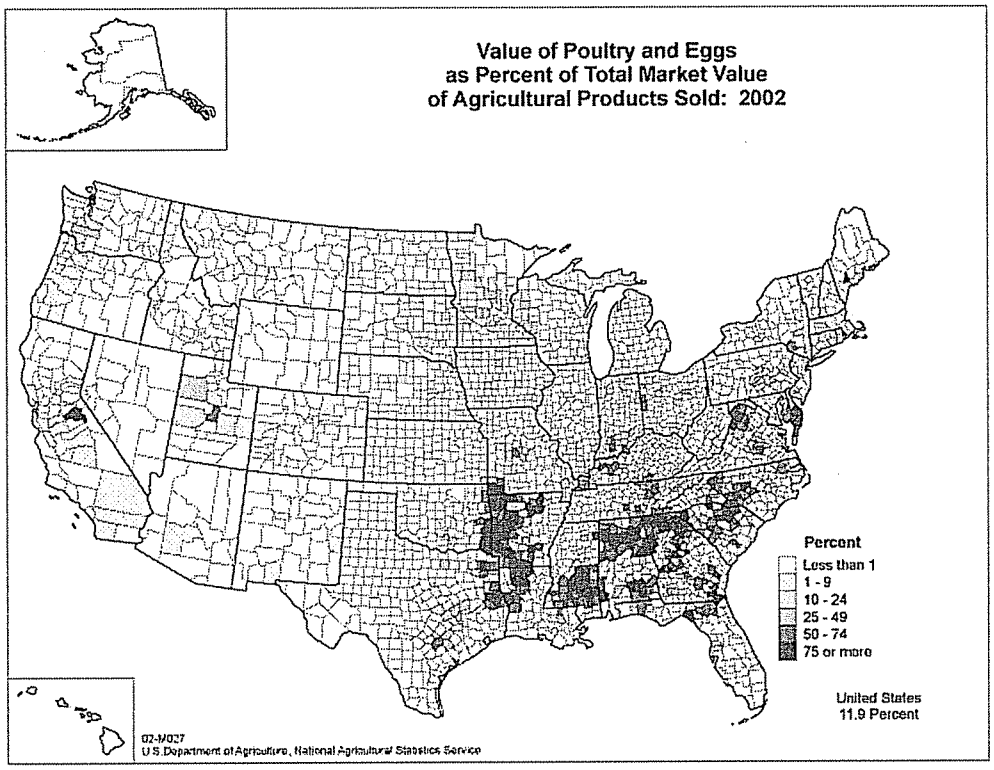
[44] Letter from Richard Payne, Peterson Farms Broiler Manager, to Contract Growers in the Eucha/Spavinam Watershed, dated October 10, 2003. Bates document KAK-000296

[45] Order Approving Settlement Agreement, Vacating Order of March 14, 2003, and Administratively Closing Case, United States District Court for the Northern District of Oklahoma, Case No. 01 CV 0900EA, July 16, 2003.

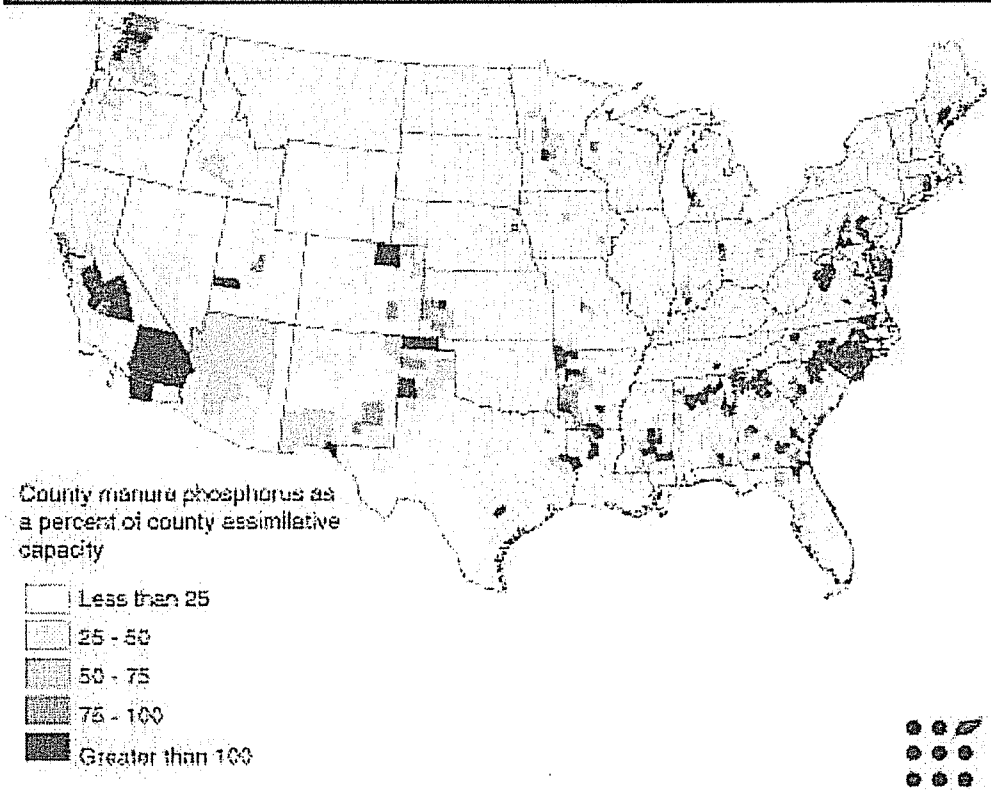
50. Integrators have tended to concentrate poultry production in a few areas of the U.S., as is evident from the USDA map shown below.



51. To highlight real and potential problems with animal waste, NRCS/USDA has produced maps for the U.S. showing counties in which there is potential for manure N, P, and K to exceed plant uptake and removal. USDA maps shown in Appendix A identify counties in which there is potential for manure P to exceed plant uptake and removal in five-year increments (agricultural Census years) from 1949 through 1997. Visual inspection of the time sequence of maps in Appendix A shows an excess of manure P in northwest Arkansas beginning in 1959 and steadily getting worse through 1997. The growing excess of manure P in the IRW is largely due to expansion of the integrated poultry industry in the area. It should be emphasized that these maps show only the annual excess of phosphorus; the ***accumulation*** of soil phosphorous is much worse than these maps indicate. Even without any added phosphorus, it could be decades before phosphorus available from the soil comes back in balance with plant needs. With current agricultural practices in the area, it will also be decades before application of phosphorus from poultry waste or commercial fertilizer will be economically justified on most fields in the IRW.

52. The USDA map showing excess phosphorus in 1997 is shown below. This is the latest map available, as USDA has not updated the study for 2002 Census data.

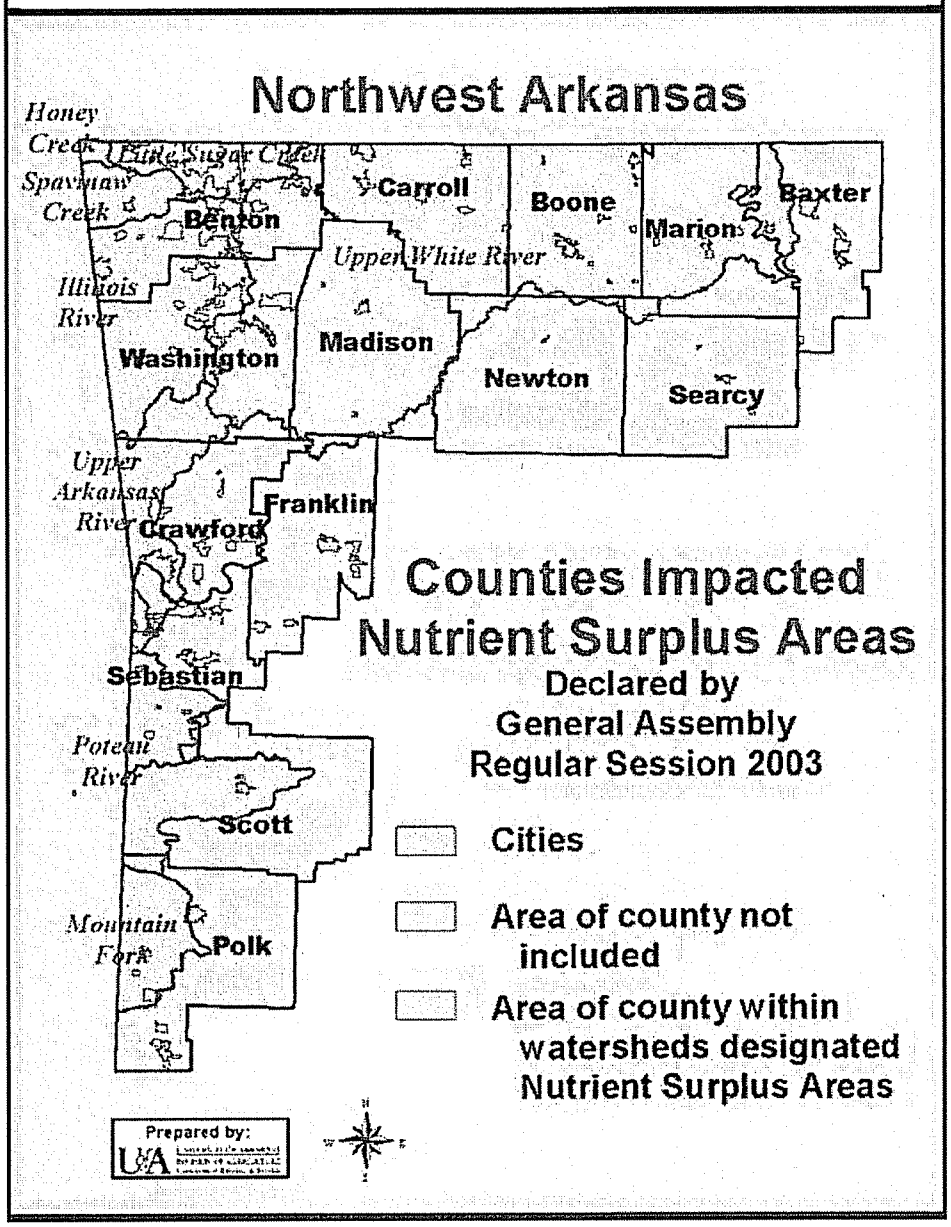
Figure 4.5.4-Excess manure phosphorus as a share of county assimilative capacity, 1997



Some counties are combined to meet disclosure criteria.
Source: Economic Research Service, USDA.

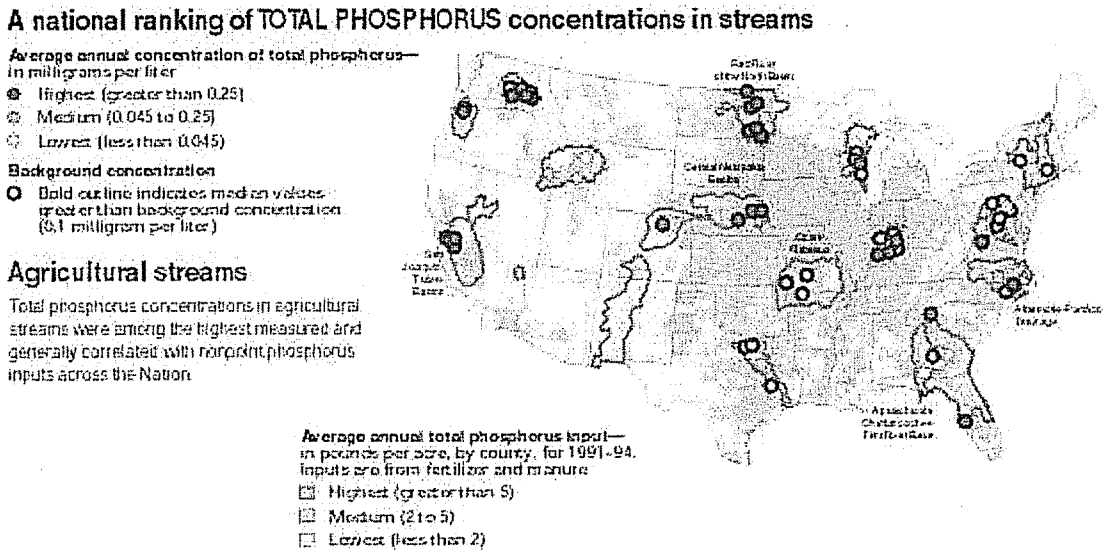
53. A 2004 University of Arkansas Cooperative Extension Bulletin presents the following map showing nutrient excesses in northwest Arkansas.[46]

Figure 2. Nutrient sensitive areas where State Acts 1059 and 1061 apply.



[46] Mike B. Daniels, Karl VanDevender and Tom Riley, Nutrient Management Planning for Livestock Operations: An Overview, University of Arkansas, Division of Agriculture, Cooperative Extension Service, Bulletin FSA9515-1.5M-5-04N

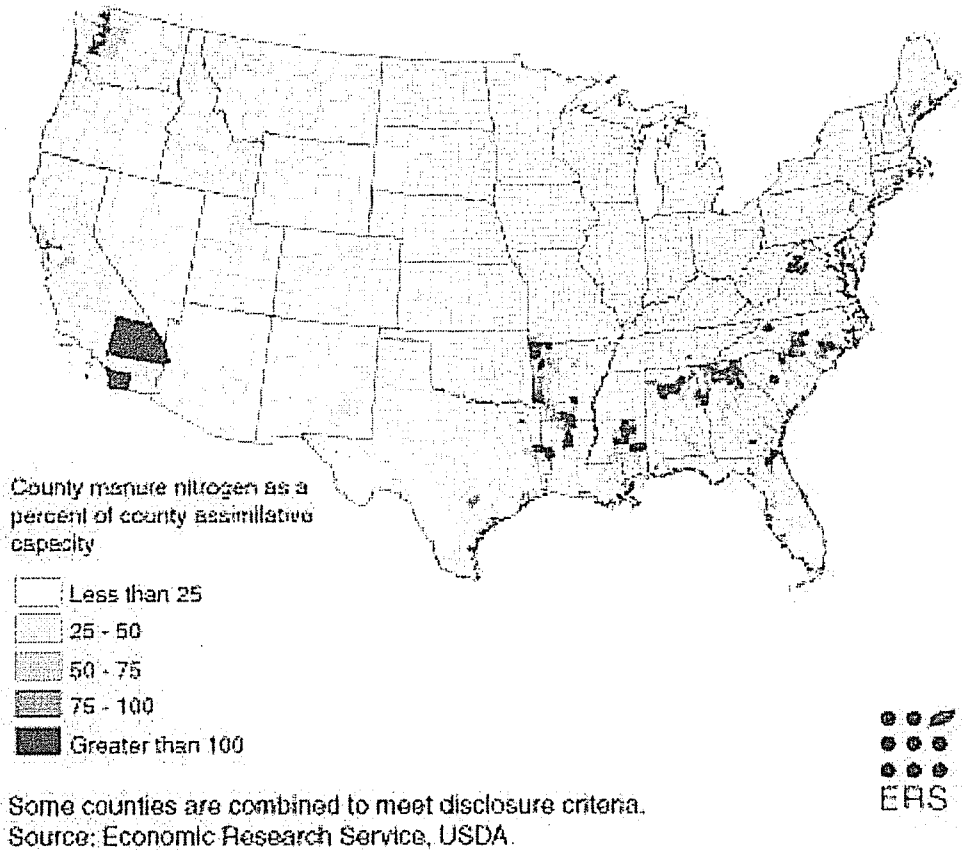
54. The U.S. Geological Survey (USGS) produced an extensive report in 1999 identifying real and potential problems with nutrients and pesticides in the nation's waters. They state, *"Elevated phosphorus concentrations in agricultural streams can also come from livestock waste, such as in Prairie Creek in the Central Nebraska Basins, or from poultry wastes, such as in streams of the Apalachicola-Chattahoochee-Flint River Basin and the Ozark Plateaus."* [47] Their report includes the following map. The Ozark Plateau area delineated on the USGS map below includes much of the ESW and IRW.



[47] U. S. Geological Survey, The Quality of Our Nation's Waters: Nutrients and Pesticides, USGS Circular No. 1225, 1999, p. 44.

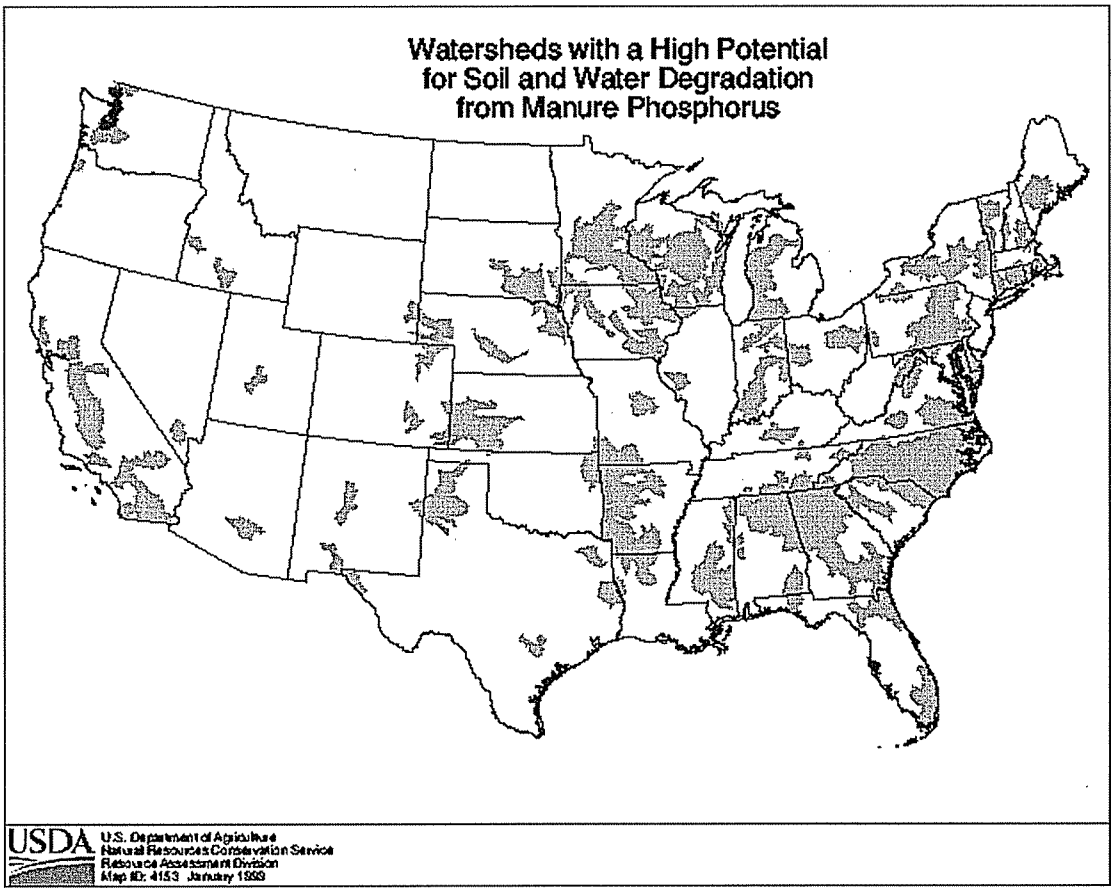
55. Excess nitrogen from livestock and poultry waste has been of concern, particularly since the early 1970s. The USDA map shown below identifies Benton and Washington Counties, in particular, as having excess nitrogen exceeding assimilative capacity in 1997.

Figure 4.5.3-Excess manure nitrogen as a share of county assimilative capacity, 1997



Some counties are combined to meet disclosure criteria.
Source: Economic Research Service, USDA.

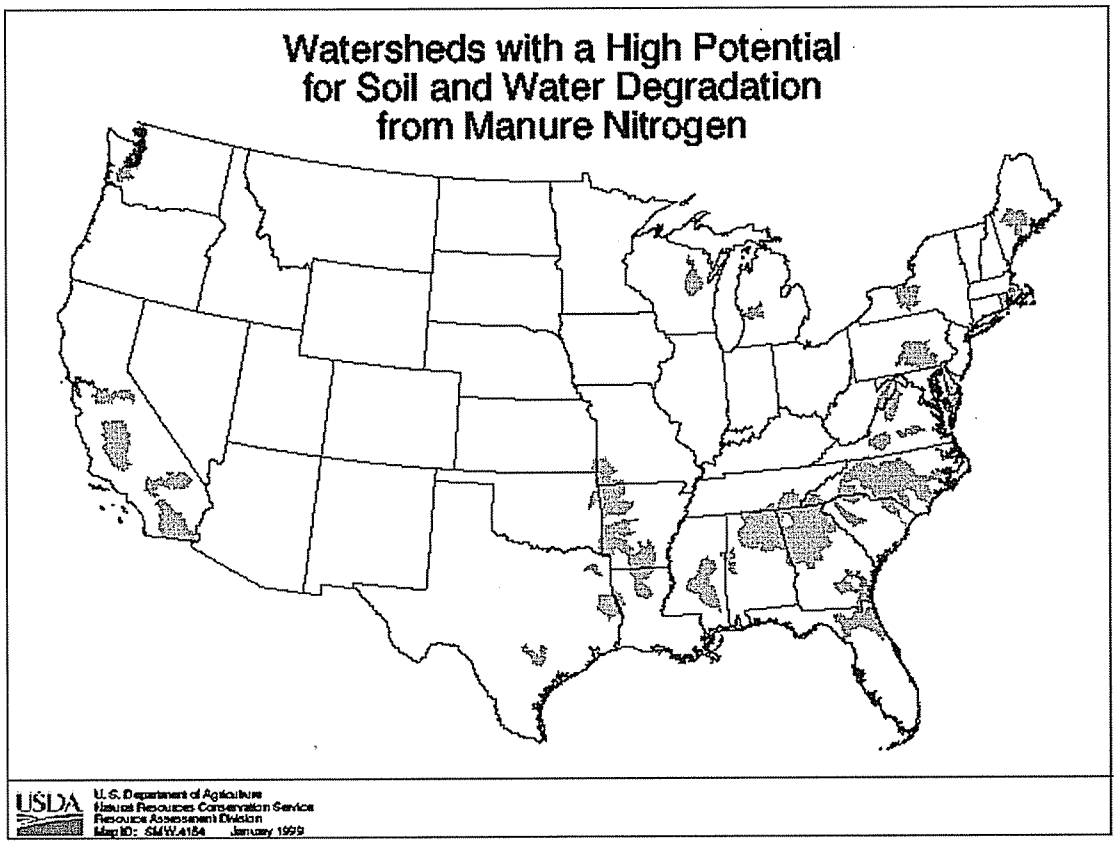
56. The USDA/NRCS map shown below identifies the northeastern Oklahoma and northwest Arkansas as one of the areas with high potential for soil and water degradation from manure phosphorus.[48] In the IRW, confined poultry operations account for most of the recoverable[49] manure.



[48] Accessed at http://www.nrcs.usda.gov/technical/NRI/pubs/ntrend.html

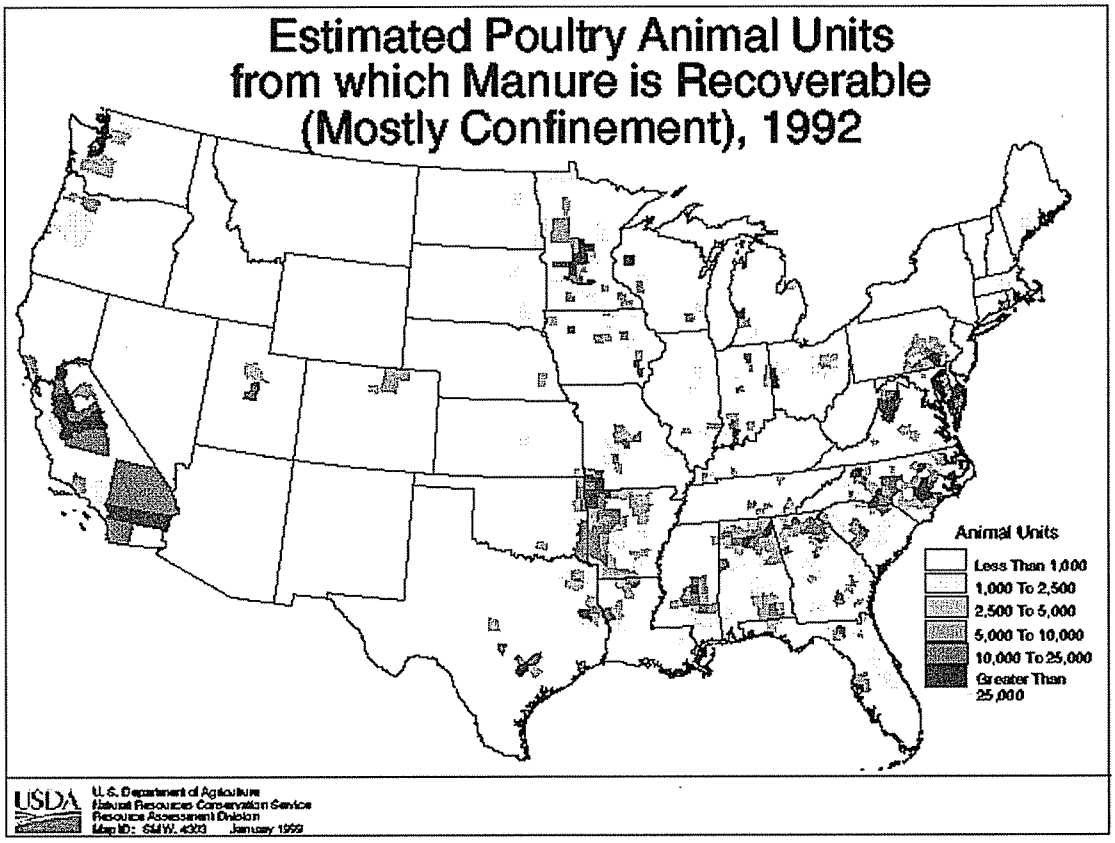
[49] Definition of recoverability and associated parameters for each state are given by Robert L. Kellogg, Charles H. Lander, David C. Moffitt, and Noel Gollehon, Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assilimate Nutrients: Spatial and Temporal Trends for the United States, USDA, NRCS, ERS, publication No. NPS00-0579, December 2000.

57. A USDA/NRCS map shown below also identifies the IRW as one of the areas with high potential for soil and water degradation from manure nitrogen.[50]



[50] Accessed at http://www.nrcs.usda.gov/technical/NRI/pubs/ntrend.html

58. Another USDA/NRCS map, shown below, identifies the IRW area as having a large amount of manure that is recoverable, unlike manure from pastured livestock.[51]



59. The above map is in terms of animal units, which is a common methodology for more directly comparing different types of livestock and poultry. As defined by USDA for purposes of the about map, 455 broilers constitute an animal unit as does a single breeding cow or bull. [52] Both Benton and Washington Counties in Arkansas are identified in the above maps as having over 25,000 animal units from which manure is recoverable. Table 1 below shows the confined animal units calculated by USDA based on 1997 Census of Agriculture. Most of the confined animal units from which manure is recoverable in the IRW are in Benton and Washington Counties.

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[51] Accessed at http://www.nrcs.usda.gov/technical/NRI/pubs/ntrend.html

[52] Parameters used to compute animal units are given in Robert L. Kellogg, Charles H. Lander, David C. Moffitt, and Noel Gollehon, Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assilimate Nutrients: Spatial and Temporal Trends for the United States, USDA, NRCS, ERS, publication No. NPS00-0579, December 2000, p. 3.

Table 1. Number of Confined Animal Units, 1997 USDA Data

County	Number of confined animal units on livestock farms
Benton County, AR	100,272
Washington County, AR	98,443
Adair County, OK	16,002
Cherokee County, OK	10,876
Delaware County, OK	26,956
Sequoyah County, OK	1,378

60. Agricultural Census data for five Counties in the IRW show that production (sales) of broilers and other meat types of poultry increased from 193,605,322 in 1987 to 291,648,825 in 2002.[53] The 2002 Census shows that 237,957,139 broilers were produced (sold) in Benton and Washington Counties, AR. The five county area had an increase in broiler numbers of over 50% from 1987 to 2002, which largely accounts for the increase in excess phosphorus as shown on the USDA maps.[54]

61. In my opinion, integrators have been well aware for about two decades that runoff and leaching of phosphorus from land application of poultry waste is of environmental concern in several areas of the U.S., including the IRW. Real and potential environmental problems associated with excess phosphorus in poultry waste have been widely discussed and researched in universities, various agencies within USDA including the Economic Research Service (ERS) and the Natural Resource Conservation Service (NRCS), and in the U.S. Environmental Protection Agency (USEPA) for over two decades as shown, in part, by the maps presented previously. There have been numerous publications, seminars, symposia, and training sessions by USDA/NRCS, USDA/ERS, State Land-Grant universities including the University of Arkansas and Oklahoma State University, and other public entities on environmental issues related to concentrated livestock and poultry waste for decades. Before concern over phosphorus came to the forefront, there was widespread concern over excess nitrogen in poultry waste applied to cropland.

[53] Sequoyah County Oklahoma was not included in the total because broiler sales data were not reported due to confidentiality in 1987, 1992 and 1997. 2002 data show slightly over 1 million broilers sold in Sequoyah County, indicating that broiler production is small in that county relative to the other five counties.

[54] The 2007 Census of Agriculture is not publicly available at this time.

62. In general, environmental concern with highly concentrated livestock and poultry production in small geographical areas has been at the forefront of economic and scientific dialog and concern at least since the early 1970s. Illustrations of the extent of awareness include the following:

    a. A March1988 report by Martin Maner, P.E., to the Arkansas Department of Pollution Control & Ecology highlighted problems with both nitrogen and phosphorus from livestock and poultry waste in Benton and Washington Counties. He emphasized the over application of nutrients, *"Nitrogen and phosphorus should be applied at a rate not greater than what cover plants can assimilate.... General guidelines for phosphorus are about 40 lbs/acre-yr and the current application rate is probably in excess of 80 lbs/acre-yr. ... Phosphorus ... absorbs to soil particles and is not readily leached from the soil. Excess values built up in the soil will be washed into surface waters whenever erosion occurs. ... Chicken manure has a higher phosphorus to nitrogen ratio than is utilized by plants. If the application of this material is based on its nitrogen content, an excess of phosphorus will build up. Informal soil tests done in the Lake Lincoln watershed in Washington County by the SCS show excess phosphorus is present. Lake Lincoln, the water supply for Lincoln, currently has dense algae blooms and taste and odor problems in the summer, an indication of nutrient enrichment."* Maner concluded, *"Over 257,100 lbs/day nitrogen and 87,400 lbs/day phosphorus are generated daily in the two county area. This is equivalent to a human population of over 8 million people. About 30% of the nitrogen and 40% of the phosphorus is from dry-litter broiler houses. ... Water supply lakes in the area have problems associated with algal blooms in the summertime."* [55]

    b. Industry awareness is evident from the biennial National Poultry Waste Management Symposia, beginning 20 years ago.[56]

    c. Proceedings of the 1992 Waste Management Symposia included a talk by Ellis Brunton, representing defendant Tyson Foods. He discussed corporate environmental commitment and discussed problems with poultry waste, including nutrients. Brunton concluded that *"the total returns on environmental investment are not yet positive,"* in apparent reference only to the integrator's returns, not full social and economic returns.[57]

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[55] Martin Maner, "Agricultural Land Use, Nutrients, and Water Quality in Benton and Washington Counties, report to the Arkansas Department of Pollution Control & Ecology, March 1988. Plaintiff's Exhibit PF-12 to the deposition of Kirk Houtchens, July 26, 2007.

[56] A list of the published proceedings of these biennial symposia is available at http://poultryextension.psu.edu/NPWMS.html

[57] Ellis W. Brunton, Ph.D., Tyson Foods, Inc., "Corporate Management Commitment to Waste and Environmental Management." Batets NPWMS00000050 – NPWMS00000053.

d. A 1994 document indicates formation of the Poultry Water Quality Consortium and identifies it as *"a cooperative effort of industry and government to identify and adopt prudent uses of poultry by-products that will preserve the quality of water for everyone."*[58]

e. The United States General Accounting Office provided an extensive briefing report to Congress in 1995 on waste management and water quality issues, including costs for poultry manure storage, composting and hauling.[59]

f. In 1996 the Council for Agricultural Science and Technology released a comprehensive report on animal waste management prepared by a committee comprised of academic scientists, engineers and economists.[60]

g. In 1997 the U.S. EPA began "an extensive effort to address growing water quality problems and public health concerns related to animal feeding operations," including a Siloam Springs, AR meeting in 1998. Attendees identified in the EPA report included representatives from the Arkansas Poultry Federation, and defendants Simmons Foods and Tyson's Foods.[61]

h. In 1998 a document titled Environmental Framework and Implementation Strategy for Poultry Operations: A Voluntary Program **Developed and Adopted by the Poultry Industry** was published and remains available on the U.S. Poultry and Egg Association web site.[62]

i. A 2001 letter to the USEPA Office of Water, John Starkey, Vice President of Environmental Programs for the U.S. Poultry and Egg Association acknowledged "Northwest Arkansas/Southwest Missouri" as one of several areas in which nutrient supply and demand on poultry farms was out of balance. The letter from Starkey shows circulation to the Board of Directors of the U.S. Poultry and Egg Association, an organization controlled by the integrators. The current Board includes employees and executives of some of the defendant companies.[63]

j. Agricultural Economists and Scientists at the University of Arkansas have been analyzing the poultry waste problem at least from the very early

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[58] Poultry Water Quality Consortium, Larry D. Goff, Liason, June 1994.
[59] United States General Accounting Office, Briefing Report to the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, Animal Agriculture: Information on Waste Management and WaterQuality Issues, GAO/RCED-95-200BR, June 1995.
[60] Council for Agricultural Science and Technology (CAST), Integrated Animal Waste Management, Task Force Report, No. 128, November 1996.
[61] EPA, Public Issues and Concerns with Animal Feeding Operations in EPA Region 6: Summary Report, July 1998.
[62] Downloaded on 10/18/2007 at http://www.poultryegg.org/Environment/STRATEGY1.html. Bold emphasis added.
[63] http://www.poultryegg.org/ContactInformation/board.html

1990s. A 1994 article by Govindasamy, Cochran and Butchberger focused on the economic opportunity costs of a proposed phosphorus management policy that targeted soil with elevated phosphorus levels in the Muddy Fork watershed of the IRW in northwest Arkansas. [64] In introducing the problem, they state, *"The most damaging and widespread environmental effect of agriculture production is the non-point source pollution created by activities such as excessive fertilizer and pesticides application and improper animal waste management (Environmental Protection Agency, 1994; National Research Council, 1989; Schultz et al., 1992; Crowder and Young, 1988). The size of the poultry industry in Arkansas has exploded in the past decade with an aim to meet the growing demand for poultry meat and egg products. Approximately 24 million chickens, 25 million turkeys, and 1 billion broilers are produced every year in the state. As a result, approximately 1.5 million tons of poultry litter are produced per year. Most of this poultry litter is applied as a fertilizer to nearby pasture lands consisting of bermuda grass and tall fescue. The fertilizer contributions of poultry litter also enhance the profitability of the beef cattle industry by providing an economical nutrient supply for forage crops in the area. However, the growth of the poultry industry has been in concentrated areas which may result in litter applications that exceed the nutrient requirements of the local forage. This may lead to excessive nutrient loadings in surface and groundwater.* ***Concern about the environmental impacts of increased nitrate, phosphorus, and bacteria levels in water supplies has been growing within the state (Decker, 1992; Griffee, 1992). The Arkansas non-point pollution assessment concluded from 1988 monitoring data that in the Ozark Highlands region 'nitrate levels … are consistently high and few streams meet the primary contact recreation standards due to high fecal coliform concentrations' (Department of Pollution Control and Ecology, 1990). The loss of phosphorus (P) in runoff from agricultural non-point sources is also gaining notoriety as a source of eutrophication (Daniel et al, 1991).*** *Ideal development of phosphorus management strategies should reflect: (1) the balance between crop needs and total available and soluble P, (2) the surface and groundwater transport processes, (3) the susceptibility of soils to erosion and runoff, and (4) proximity of sources to surface water sensitive to eutrophication."*[65]

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[64] R. Govindasamy, M. J. Cochran, and E. Buchberger, "Economic Implications of Phosphorus Loading Policies for Pasture Land Applications of Poultry Litter," Water Resources Bulletin, Vol.30, No. 5, October 1994: 901-910.

[65] Bold emphasis added.

63. From the early 1990s, there have been numerous economic studies addressing the broad topic of removing excess poultry waste from watersheds in which nutrients, particularly phosphorus, exceed the assimilative capacity of available land. Notable studies include the following:

    a. Bosch and Napit (1991) examined the economics of transporting broiler litter to achieve more effective use as a fertilizer in Virginia. [66]

    b. Schnitkey and Miranda (1993) examined the long-run effects of phosphorus runoff controls on optimal livestock production and manure application practices, with application in the Midwest hog-corn system. [67]

    c. Govindasamy, Cochran and Butchberger (1994) examined the economics of phosphorus policy in the Muddy Fork watershed of the IRW. [68]

    d. Govindasamy and Cochran (1995) studies the economic feasibility of transporting poultry litter from northwest Arkansas to Delta row crop production. [69]

    e. Martin and Zering (1997) considered the policy implications of relationships between industrialized poultry production and the environment. [70]

    f. McIntosh, Park and Karnum (1997) examined the impact of nutrient management legislation on the U.S. broiler industry. [71]

    g. Innes (2000) developed a theoretical model to examine the aggregate economic efficiency effects of alternative livestock waste regulatory options. [72]

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[66] Bosch, D.J., and K.B. Napit. "The Economic Potential for More Effective Poultry Litter Use in Virginia." Pub. No, SP-91- 11, Dept. of Agr, and Appl. Econ., Virginia Polytechnic Institute and State University, Blacksburg, 1991.

[67] Gary D. Schnitkey and Mario J. Miranda, "The Impact of Pollution Controls on Livestock-Crop Producers," Journal of Agricultural and Resource Economics, Vol. 18, July 1993: 25-36.

[68] R. Govindasamy, M. J. Cochran, and E. Buchberger, "Economic Implications of Phosphorus Loading Policies for Pasture Land Applications of Poultry Litter," Water Resources Bulletin, Vol.30, No. 5, October 1994: 901-910.

[69] Ramu Govindasamy and Mark J. Cochran, "The Feasibility of Poultry Litter Transportation from Environmentally Sensitive Areas to Delta Row Crop Production," Agricultural and Resource Economics Review, April 1995.

[70] Laura L. Martin and Kelly D. Zering, "Relationships Between Industrialized Agriculture and Environmental Consequences: The Case of Vertical Coordination in Broilers and Hogs," Journal of Agricultural and Applied Economics, Vol. 29, July 1997:45-56.

[71] Christopher S. McIntosh, Timothy A. Park, and Chandrashekar Karnum, "The Potential Impact of Nutrient Management Legislation on the U.S. Broiler Industry," Paper presented at the Western Agricultural Economics Association Annual Meeting, July 13-16, 1997, Reno, NV.

[72] Robert Innes, "The Economics of Livestock Waste and Its Regulation," American Journal of Agricultural Economics, Vol. 82, February 2000:97-117.

h. Paudel and McIntosh (2000) examined optimal poultry litter utilization for phosphorus disposal in Georgia. [73]

i. Goodwin, Hipp and Wimberly (2000) examined a third-party enterprise for moving large quantities of poultry waste off farms. [74]

j. Yang, Bosch, Nordberg and Wolfe (2000) examined the effects of phosphorus based nutrient management plans on dairy and poultry farms in Virginia, and also addressed environmental risks. [75]

k. Pease (2000) provided a cooperative extension bulletin on transportation issues using litter as a nutrient source in Virginia. [76]

l. Pelletier, Pease and Kenyou (2001) examined the economics of poultry waste transportation in Virginia. [77]

m. Jones and D'Souza (2001) examined trading poultry litter in West Virginia. [78]

n. Lichtenberg, Parker and Lynch (2002) examined long distance transport of litter off the Delmarva Peninsula. [79]

o. Adhikari, Paudel and Martin (2002) evaluated broiler litter transportation in northern Alabama. [80]

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[73] Krishna P. Paudel and Christopher S. McIntosh, "Economics of Poultry Litter Utilization and Optimal Environmental Policy for Phosphorus Disposal in Georgia," paper presented at the Southern Agricultural Economics Association annual meeting, Lexington, KY, January 29-February2, 2000.

[74] H. L. Goodwin, Janie Hipp, and Jim Wimberly, "Off-Farm Liter Management and Third-Party Enterprises," Paper prepared for the Foundation for Organic Resources Management for Winrock International under a USDA grant, January 2000.

[75] Xiao Yang, Darrell J. Bosch, Tone Nordberg, and Mary Leigh Wolfe, "Phosphorus-Based Nutrient Management Planning on Dairy/Poultry Farms: Implications for Economic and Environmental Risks," Paper presented at the annual meeting of the American Agricultural Economics Association, Tampa, FL, July 30-August 2, 2000.

[76] Jim Pease, "Transport Issues in Using Litter as a Nutrient Source," Farm Business Management Update, Virginia Cooperative Extension Service, Virginia Tech University, August 2000.

[77] Beth Ann Pelletier, James Pease, and David Kenyon, Economic Analysis of Virginia Poultry Litter Transportation, Virginia Agricultural Experiment Station Bulletin 01-1, February 2001.

[78] Kezelee Jones and Gerard D'Souza, "Trading Poultry Litter at the Watershed Level: A Goal Focusing Application," Agricultural and Resource Economics Review, Vol. 30, April 2001: 56-65.

[79] Erik Lichtenberg, Doug Parker and Lori Lynch, "Economic Value of Poultry Litter Supplies in Alternative Uses," Policy Analysis Report No. 02-02, Center for Agricultural and Natural Resource Policy, University of Maryland, October 2002.

[80] Murali Adhikari, Krishna P. Paudel, and Neil R. Martin, Jr., "An Economic Strategy for Preventing Water Pollution by Using a Phosphorus Consistent Transportation Model: A Case of Broiler Litter Management," Department of Agricultural Economics, Report 100-2002, Louisiana State University, 2002.

p. Ancev, Stoecker and Storm (2003) use a GIS model to derive spatially optimal least-cost allocation of management practices to reduce phosphorus runoff in the Eucha-Spavinaw watershed. [81]

q. Ancev, Stoecker and Storm (2003) examined transportation of litter within and out of the Eucha-Spavinaw watershed. [82]

r. Paudel, Hite, Intarapapong, and Susanto (2003) examined the economic optimum broiler litter application considering water quality standards. [83]

s. Parker (2004) studies the economics of creating markets for manure with reference to the Chesapeake Bay Region which has a high concentration of poultry. [84]

t. Guru and Goodwin (2004) examined policy and economic implications of self-regulation of poultry waste in the IRW and ESW. [85]

u. Carreira, Young and Goodwin (2005) focused on the economics of removing excess poultry waste from northwest Arkansas and transporting it to Delta row crop production. [86]

v. Collins and Basden (2006) examine poultry litter transport in West Virginia. [87]

w. Bonham, Bosch and Pease (2006) studies cost-effective agricultural nutrient mangement alternatives for the Chesapeak Bay area. [88]

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[81] Tihomir Ancev, Arthur L. Stoecker and Daniel E. Storm, "Least-Cost Watershed Management Solutions: Using GIS Data in Economic Modeling of a Watershed," Paper presented at the Southern Agricultural Economics Association Annual Meeting, February, 2003.

[82] Tihomir Ancev, Arthur L. Stoecker and Daniel E. Storm, "Optimal Spatial Allocation of Waste Management Practices to Reduce Phosphorus Pollution in a Watershed," Paper presented at the American Agricultural Economics Association Annual Meeting, Montreal, Canada, July 27-30, 2003.

[83] Krishna P. Paudel, Diane Hite, Walaiporn Intarapapong, and Dwi Susanto, "A Watershed-Based Economic Model of Alternative Management Practices in Southern Agricultural Systems," Journal of Agricultural and Applied Economics, Vol. 35, August 2003: 381-390.

[84] Doug Parker, "Creating Markets for Manure: Basin-Wide Management in the Chesapeake Bay Region," paper presented at the joint annual meeting of the Northeast Agricultural and Resource Economics Association and the Canadian Agricultural Economics Society, Halifax, Nova Scotia, Canada, June 20-23, 2004.

[85] Manjula V. Guru and H. L. Goodwin, "The Case for Acceptable Levels of Environmental Self-Regulation in the Poultry Industry: Policy and Economic Implications," paper presented at the American Agricultural Economics Association Annual Meeting, Denver, CO, August 1-4, 2004.

[86] R. I. Carreira, K. B. Young, and H. L. Goodwin, "Too Litter, Too Late: Economic Logistics of Transporting Nutreint Rick Poultry Litter Out of Nutrient-Saturated Regions," paper presented at the American Agricultural Economics Association Annual Meeting, Providence, RI, July 24-27, 2005.

[87] Alan R. Collins and Tom Basden, "A Policy Evaluation of Transport Subsidies for Poultry Litter in West Virginia," Review of Agricultural Economics, Vol. 28, 2006:72-88.

x. Parker and Li (2006) analyses poultry litter use and transportation on Marlyland's eastern shore. [89]

y. Willett, Mitchell, Goodwin, Vieux and Popp (2006) analyze the opportunity cost of regulating phosphorus from broiler production in the Illinois River Basin.[90]

z. Bhattarai and Paudel (2006) examine the feasibility of broiler manure tranportation and application in crop production in Louisiana. [91]

aa. Carreira, Goodwin and Hamm (2006) identified problems that prevent a litter market from fully developing. [92]

bb. Stoecker, Marumo, Machooka, Howry, Storm and White (2007) examine poultry waste use and transportation in the ESW under alternative pollution constraints. [93]

cc. Carreira, Young, Goodwin and Wailes (2007) optimized the transport of poultry waste out of the ESW and IRW to cropland in Eastern Arkansas. [94]

dd. Kemper, Goodwin and Mazaffari (2008) examine the value of baled broiler litter for cotton production in the Arkansas Delta. [95]

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[88] John G. Bonham, Darrell J. Bosch and James W. Pease, "Cost-Effectiveness of Nutrient Management and Buffers: Comparisons of Two Spatial Scenarios," Journal of Agricultural and Applied Economics, Vol. 38, April 2006: 17-32.

[89] Doug Parker, and Qing Li, "Poultry Litter Use and Transport in Caroline, Queen Anne's, Somerset and Wicomico Counties in Maryland: A Summary Report," Mid-Atlantic Regional Water Program, MAWP 0601, January 2006.

[90] Keith Willett, David M. Mitchell, H. L. Goodwin, Baxter Vieux, and Jennic S. Popp, "The Opportunity Cost of Regulating Phosphorus from Broiler Production in the Illinois River Basin," Journal of Environmental Planning and Management, Vol 49, March 2006: 181-207.

[91] Keshav Bhattarai and Krishna P. Paudel, "Assessing the Feasibility of Broiler Manure Transportation and Application in Crop Production under Environmental Restrictions," paper presented at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 5-8, 2006.

[92] R. I. Carreira, H. L. Goodwin, and S. J. Hamm, "How Much is Poultry Litter Worth?" paper presented at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, Feb. 4-8, 2006.

[93] Arthur Stoecker, Davis S. Marumo, Stella Machooka, Sierra Howry, Daniel Storm and Michael White, "Determination of Least Cost Phosphorus Abatement Practices in a Watershed Under Stochastic Conditions," paper presented at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29-August1, 2007.

[94] R. I. Carreira, K. B. Youg, H.L. Goodwin and E.J. Wailes, "How Far Can Poultry Litter Go? A New Technology for Litter Transport," Journal of Agricultural and Applied Economics, Vol. 39, December 2007:611-623.

[95] Nathan Kemper, H. L. Goodwin, and Morteza Mozaffari, "The Nitrogen Fertilizer Value of Baled Broiler Litter for Cotton Production in the Arkansas Delta," paper presented at the Southern Agricultural Economics Association Annual Meeting, Dallas, TX, February 2-5, 2008.

64. A 2007 article published by University of Arkansas agricultural economists Carreira, Young, Goodwin and Wailes describe the excess poultry waste problem as well as potential solutions, particularly for the IRW. They state, "*Certain regions face nutrient excess problems (Kellogg et al) likely due to the dramatic change over the past two decades in the structure of the animal industry in the United States, which has become highly vertically integrated (Vukina and Foster).* ***Farmers' perception of manure management has evolved from crop fertilization to waste disposal*** *(Parker). While inappropriate manure application rates can create environmental stress (Sharpley et al.), properly used poultry manure enhances soil qualities by supplying organic matter, nutrients, enzymes, and bacteria and helping maintain soil pH at desirable acidic levels (Zhang and Hamilton). The two key poultry counties in Arkansas, Benton and Washington, are located in the northwest part of the state and produce over 237 million broilers per year (USDA-NASS), corresponding to 20% of the state's total broiler production; the production of turkeys and layers is also important to the region. Over the last 20 years, the availability of poultry manure was considered a major benefit to poultry growers who relied on this resource to improve pasture yield for cattle production. Because the application rates were nitrogen (N)-based and removal of other nutrients was limited, soil phosphorus (P) levels increased over time. A best management practice (BMP) application rate for pasture land between ... 4 and 5 tons/acre ... is unsustainable today in northwest Arkansas. If a P-based application rate were implemented, over ... 300,000 tons of surplus poultry litter from these two counties could be available for export annually.*"[96]

65. Carreira, Young, Goodwin and Wailes conclude that *"Exporting northwest Arkansas excess turkey and broiler litter to partially fertilize nutrient deficient cropland in eastern Arkansas can be more cost effective than to supply all crop nutrients with chemical fertilizer only, given current high fertilizer prices. Cost savings are greater if litter is baled in ultraviolet resistant plastic and transported via truck ... Rice is the crop that allows for greater savings ..."* They also concluded, "*Without baling or backhaul trucking rates, it would still be cost efficient to transport part of the litter and use it instead of chemical fertilizer."* They note that *"... the litter baler is still under development and the costs and performance still have not been tested under actual production conditions."*

66. To the extent that phosphorus levels in IRW pasture and forage fields already exceed the maximum agronomic rates, which is associated with 100% crop or forage yield, additional phosphorus from any source, poultry waste or commercial fertilizer, does not enhance crop or cattle production in the area.

67. It is universally recognized in agricultural economics that the most profitable fertilizer application rate occurs at a yield level below the agronomic maximum yield

[96] Bold emphasis added.

level of 100%, as long as fertilizer and its application are not free[97]. Worded another way, the most profitable fertilizer application rate is associated with a soil phosphorus test level less than that associated with the agronomic maximum yield.

68. A common, but usually incorrect, way of placing a gross value on poultry waste is based on a cost comparison with commercial fertilizer. [98] For example, the Oklahoma NRCS Information Sheet, Poultry Litter Manure Transfer Incentives, makes such a calculation, *"Using current 2005 prices for N-P-K bought commercially, a ton of broiler litter would be worth $41.96/ton."* In fact, such a calculation only establishes the **maximum** gross value of poultry waste, which typically overstates the value of poultry waste because plant nutrients in poultry waste are often in the wrong proportions for optimal usage by plants. In particular, soil P (and K) test results for the IRW indicate that most fields have P levels so high that there is no plant (e.g. forage) yield response to additional P. Therefore there is "zero" gross value to additional P applied either as poultry waste or as commercial fertilizer. In other words, there is no gross value attached to phosphorus in poultry waste applied to land in the IRW, and it is incorrect to use a commercial phosphorus price to value poultry waste for application to fields in the IRW that already exceed the agronomic maximum phosphorus.

69. To the extent that soil phosphorus and potassium already exceed the economic and agronomic maximums, then P and K have no value when applied to soils in the IRW. However, if soil P and K do not exceed maximums, as appears to be the case with cropland in the Arkansas Delta, for example, then they may have value.

70. Plaintiff Expert Johnson indicates that many of the IRW soils are also high in available N, as is supported by the USDA map and data shown previously. [99] To the extent that available N in an IRW field meets economic or agronomic needs, nitrogen in poultry waste or commercial fertilizer also has no gross value on that field.

71. Widespread recognition of the problem of excess poultry waste in several areas of the U.S., including the IRW, has led researchers to consider a variety of alternatives to land application of waste in problem watersheds.[100] Alternatives include low phosphorus diets for poultry, amendments such as alum applied to the waste, composting for sale in urban areas, and both on-farm and large-scale burning. Although burning poultry waste is technically feasible, even on a small-scale, a University of Arkansas study shows that technical improvements are required before

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[97] This also assumes that the law of diminishing returns applies to crop and pasture fertilization. Validity of this assumption has been verified by practically all fertilization experiments conducted for well over a century.

[98] See, for example, Martin and Zering, p. 50.

[99] Affidavit of Gordon V. Johnson, Nov. 8, 2007.

[100] Several alternatives are reviewed in Marc Ribaudo, Noel Gollehon, Marcel Aillery, Jonathan Kaplan, Robert Johansson, Jean Agapoff, Lee Christensen, Vince Breneman, and Mark Peters, Manure Management for Water Quality: Costs to Animal Feeding Operations of Applying Manure Nutrients to Land, USDA Economic Research Service Agricultural Economic Report Number 824, June 2003, pp 45-53.

burning is economically feasible.[101] While some of these alternatives may become economically viable in the future, the consensus of economic analyses focused on the ESW and IRW point to transportation of the excess waste to Eastern Arkansas Delta cropland that is deficient in plant nutrients. Based on extensive economic analyses done by agricultural economists at the University of Arkansas and Oklahoma State University, it is assumed that the most viable alternative use of excess litter from the IRW is on cropland in the Delta area of Eastern Arkansas.

72. Historically, it was not profitable to haul litter long distances because commercial fertilizer was much cheaper than now.[102] In recent years, fertilizer prices have increased faster than transportation charges, extending the distance poultry waste can be profitably hauled. A 2007 study by Carreira, Young, Goodwin and Wailes indicates that with prices prevailing at the time, it was profitable to transport **all** poultry litter out of the ESW and IRW, assuming development of a centralized market and litter baling technology. Without litter baling technology (i.e. hauling loose waste), their results also showed that it was profitable to haul 74,413 tons of the poultry litter produced in the IRW and apply it to rice in Lonoke County Arkansas. Thus, at present there is no apparent economic barrier to the defendant companies behaving responsibly and hauling substantial amounts of poultry waste, if not all of the waste, out of the IRW.

73. The Carreira, Young, Goodwin and Wailes study provides cost information to assess how much the defendant companies enriched themselves in the past by not responsibly transporting poultry waste out of the IRW for application on nutrient deficient cropland. Table 2 summarizes cost items for collecting loose litter in the IRW and transporting it unbaled (i.e. loose) to Arkansas Delta cropland. These calculations can be updated in the future, as needed, if fuel or fertilizer prices change substantially.

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[101] Thomas A. Costello, "Feasibility of On-Farm Broiler Litter Combustion," Avian Advice, Spring 2007, pp 7-13.

[102] Other litter options, such as burning, appear less viable economically under present economic conditions than transporting litter for utilization in crop production outside the IRW.

Table 2. Summary of Cost Data for Using Unbaled Poultry Litter (from Carreira, et al, 2007)

Item		Cost/T
Capital Costs		
	Conveyor	$0.09
	Bobcat	$0.13
	Trailer	$0.03
	Truck for trailer	$0.08
Site costs		
	Office	$0.02
	Scales	$0.04
	Land	$0.18
	Infrastructure	$0.12
Operating costs		
	Record keeping	$0.20
	Supervision	$0.50
	Field foreman	$0.24
Other Costs		
	Obtaining litter from farm	$7.00
	Load litter in truck	$2.00
	Unload litter from truck	$2.00
	Cleaning fee for trucks	$2.00
	Storage in hoop building	$3.00
	Unload litter to spreader	$2.00
	Application	$7.00
	Disking	$6.00
Haul loose litter without backhaul (cost per mile per ton)		$0.11

74. Cost of loading, transporting and applying litter shown in Table 2 are comparable to inflation-adjusted costs from other academic studies,[103] testimony from poultry litter applicators Michael Langley[104] and Michael Traylor, [105] a USDA study by economists,[106] and information published by the Oklahoma NRCS.[107]

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[103] Pease (2000), Govindasamy and Cochran (1995), Adhikari, Paudel and Martin (2002), Bhattarai and Paudel (2006), and Stoecker, Marumo, Machooka, Howry, Storm and White (2007)
[104] Deposition of Michael Langley, November 7, 2007.
[105] Deposition of Michael Traylor, November 27, 2007.
[106] Marc Ribaudo, Noel Gollehon, Marcel Aillery, Jonathan Kaplan, Robert Johansson, Jean Agapoff, Lee Christensen, Vince Breneman, and Mark Peters, Manure Management for Water Quality: Costs to Animal Feeding Operations of Applying Manure Nutrients to Land, USDA Economic Research Service Agricultural Economic Report Number 824, June 2003, pp. 59-61
[107] Oklahoma NRCS Information Sheet, Poultry Litter Manure Transfer Incentives Through the Environmental Quality Incentives Program (EQUIP), January 2006.

75. Results from the Carreria, et al, detailed economic optimization model show poultry waste from the IRW being used exclusively on rice in the Delta. Results from the model indicate the acreage of rice in each of four counties on which poultry waste would be applied. They assumed a central collection point in the IRW would be Siloam Springs and/or Prairie Grove. The acreage and distance of each rice area from the central collection area in the IRW can be used to approximate their methodology for purpose of establishing the net cost defendants avoided by not responsibly transporting excess litter out of the IRW.[108]

76. Table 3 gives the nutrient requirements of rice as shown in the 2008 cost of production budget published by the University of Arkansas.[109] The nutrient analysis of poultry litter shown in Table 3 is that used in Carreira, et al, and assumed here.

Table 3. Nutrient Assumptions

Nutrient	Nutrient Requirements of Rice (lbs/acre)	Nutrient Analysis of Litter (lbs/T)*	Nutrient Supply from Litter	Nutrients Needed from Supplemental Commercial Fertilizer (lbs/ac)	Conversion Factor
N	153	42	44.2	108.8	1
P2O5	60	57	60.0	0.0	0.437
K2O	90	52	54.7	35.3	0.83
Tons Litter/Acre of Rice based on P max			1.053		

* Nitrogen analysis assumes 60 lbs of N/T but that only 70% is available (from Carreira, et al, 2007)

77. It is assumed that 70% of the 60 lb/T of nitrogen in litter (Table 3) would be available for plant use.[110] Consistent with the Carreira, et al, study, it was assumed that the litter application rate on rice was 1.05 T/ac, which exactly meets the phosphorus needs of rice, but does not fully meet the nitrogen or potassium requirements.

78. Table 4 shows my calculation of the costs defendants avoided by not transporting poultry waste from the IRW for use in rice production in eastern Arkansas as related

[108] Calculations shown in this report could be refined somewhat by using the optimization model in the Carreira, et al, study using historical fertilizer prices and not just using current prices and costs as they did.
[109] Brad Watkins, Jeffrey Hignight, and Charles E. Wilson, Jr., "Estimated 2008 Costs of Production, Rice Silt Loam, Eastern Arkansas," University of Arkansas Division of Agriculture, Cooperative Extension Service, downloaded at http://www.aragriculture.org/crops/rice/budgets/2008/AG1078.pdf
[110] Carriera, et al, also consider a scenario in which only 50% of the nitrogen in litter would be available. The Oklahoma NRCS Information Sheet on Poultry Litter Manure Transfer Incentives assumes that 60% of the nitrogen would be available. Economic estimates presented in this report can be refined if it is determined that the assumed 70% is inappropriate. The higher the percentage of available nitrogen in litter, the higher the value of litter applied to nitrogen deficient crops.

to hauling distances.[111] A positive value in this table indicates costs that the defendants' avoided by not transporting litter outside the IRW, while a negative value indicates a profit or benefit not realized because they did not transport litter outside the watershed.

Table 4. Real (in 2008 dollars) Difference Between Total Cost of Applying Litter Supplemented with Commercial Fertilizer and Total Cost of Using Commercial Fertilizer Only in Rice Production in Eastern Arkansas ($/T) for a hauling distance of:

Year	200	250	275	325
1988	-$0.14	$5.69	$8.61	$14.43
1989	-$1.13	$4.71	$7.63	$13.46
1990	$7.31	$13.18	$16.12	$22.00
1991	$4.70	$10.47	$13.35	$19.12
1992	$8.09	$13.81	$16.67	$22.39
1993	$10.88	$16.60	$19.46	$25.18
1994	$9.78	$15.52	$18.40	$24.15
1995	$5.05	$10.84	$13.73	$19.52
1996	$3.63	$9.41	$12.30	$18.09
1997	$5.43	$11.13	$13.98	$19.68
1998	$7.81	$13.32	$16.07	$21.58
1999	$9.27	$14.76	$17.51	$23.01
2000	$12.45	$18.09	$20.92	$26.56
2001	$7.54	$13.07	$15.83	$21.36
2002	$13.22	$18.61	$21.31	$26.70
2003	$9.03	$14.46	$17.17	$22.61
2004	$7.26	$12.73	$15.47	$20.95
2005	$2.08	$7.73	$10.56	$16.20
2006	-$0.40	$5.29	$8.14	$13.83
2007	-$10.04	-$4.39	-$1.56	$4.09
2008	-$47.90	-$42.09	-$39.19	-$33.38

79. Table 4 shows that it would have been profitable to transport poultry waste out of the IRW in 2006 up to slightly over 200 miles. This result is consistent with the Carreira, et al, finding that it was profitable to transport loose litter to rice fields closest to the IRW (Lonoke County, AR), but not to more distant rice fields in Arkansas (Monroe and Poinsett Counties), assuming fertilizer prices in 2006.

80. Results in Table 4 indicate that with the higher fertilizer prices in 2007, it would have been profitable to haul poultry waste generated in the IRW to eastern Arkansas

[111] Calculations shown in Table 4 can be refined with more detailed data on location of specific fields outside the IRW that might safely and effectively use poultry waste, crops grown on those fields, specific nutrient requirements of each crop, and soil fertility information on each field. Such refinement might necessitate setting up a complex economic optimization model similar to that employed by Carreira, et al.

rice fields as far away as about 300 miles, while even higher fertilizer prices in 2008 indicate that it would have been profitable to haul the litter over 325 miles. For most prior years, however, it was not profitable to transport large quantities of poultry waste out of the IRW to eastern Arkansas cropland, as indicated in Table 4.

81. Table 5 shows the aggregate cost defendants avoided by not responsibly transporting excess litter out of the IRW for use in rice production in eastern Arkansas. The table shows costs avoided for various quantities of excess litter not removed, by year 1988-2008.

Table 5. Costs Avoided from Not Transporting Poultry Waste Out of the IRW to Eastern Arkansas Crop Land for Various Quantities of Waste, by Year, 1988-2008, current dollars

	Tons of Poultry Waste Transported Out of the IRW Annually:						
Year	50,000 T	100,000 T	150,000 T	200,000 T	250,000 T	300,000 T	350,000 T
1988	$0	$161,393	$591,535	$1,302,413	$2,024,085	$2,745,756	$3,467,427
1989	$0	$62,721	$444,040	$1,106,467	$1,779,716	$2,452,966	$3,126,215
1990	$365,267	$907,125	$1,713,091	$2,802,483	$3,902,652	$5,002,820	$6,102,988
1991	$235,241	$643,651	$1,311,087	$2,256,382	$3,212,281	$4,168,180	$5,124,079
1992	$404,449	$980,672	$1,813,784	$2,922,621	$4,041,925	$5,161,229	$6,280,534
1993	$543,755	$1,259,434	$2,232,183	$3,480,980	$4,740,212	$5,999,444	$7,258,675
1994	$488,785	$1,150,215	$2,069,811	$3,266,578	$4,473,841	$5,681,103	$6,888,366
1995	$252,394	$678,675	$1,365,053	$2,330,452	$3,306,495	$4,282,538	$5,258,580
1996	$181,650	$536,934	$1,151,960	$2,045,562	$2,949,812	$3,854,063	$4,758,313
1997	$271,394	$714,071	$1,412,944	$2,386,676	$3,370,884	$4,355,093	$5,339,301
1998	$390,278	$946,056	$1,749,343	$2,818,285	$3,897,312	$4,976,339	$6,055,366
1999	$463,332	$1,091,790	$1,967,174	$3,107,657	$4,258,180	$5,408,703	$6,559,226
2000	$622,283	$1,414,169	$2,459,631	$3,777,467	$5,105,571	$6,433,675	$7,761,779
2001	$377,107	$920,201	$1,711,532	$2,769,290	$3,837,166	$4,905,042	$5,972,918
2002	$661,180	$1,484,281	$2,549,450	$3,874,695	$5,209,723	$6,544,751	$7,879,779
2003	$451,259	$1,065,696	$1,924,147	$3,044,567	$4,174,910	$5,305,253	$6,435,596
2004	$362,863	$890,218	$1,663,581	$2,700,966	$3,748,382	$4,795,798	$5,843,215
2005	$104,247	$378,132	$905,799	$1,705,585	$2,515,797	$3,326,008	$4,136,219
2006	$0	$131,026	$537,800	$1,218,726	$1,910,195	$2,601,664	$3,293,134
2007	$0	$0	$0	$0	$0	$0	$0
2008	$0	$0	$0	$0	$0	$0	$0
Cumulative (in 2008 dollars without interest)	**$6,175,484**	**$15,416,460**	**$29,573,943**	**$48,917,852**	**$68,459,138**	**$88,000,425**	**$107,541,711**

82. Table 5 above shows the cumulative cost defendants avoided by not transporting excess poultry waste out of the IRW. These costs can be calculated for individual defendants.

83. Prejudgment or post judgment interest, if appropriate, can be added to the costs avoided shown in Table 5 above.

C. Robert Taylor, Ph.D.

May 15, 2008
Date