Introduction

Concerns for the environment and water quality have prompted greater scrutiny of poultry feeding and management practices. Nationwide, poultry producers are faced with new regulations or anticipated legislation that will impact how poultry manure is managed. An aggressive model to which U. S. lawmakers have looked is the Netherlands' Policy on Manure and Ammonia (Anonymous 1993). In three phases, the Dutch are pursuing a target of nutrient equilibrium, e.g., balancing nitrogen (N) and phosphorus (P) applications with crop utilization. Best management practices for poultry manure call for nutrient and energy recycling. Although the options are numerous, the more practical manure recycling applications are as a fertilizer, feed, or fuel source.

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An old concept with a new application is the use of poultry or livestock manure as a fuel source for generating heat or electricity. Air-dried broiler litter has been explored as a fuel source for brooding broiler chicks (Smith et al. 1978). Litter includes fecal excretions, bedding materials (usually wood shavings) feathers, dander, and moisture from the excretions and drinking system. Other studies have shown chicken manure to have a fuel value (4,400 btu/lb) about one third of the value of coal (12,800 btu/lb) and about two thirds of the value of cordwood (6,700 btu/lb) (Sorbel and Ludington 1966). Manure includes fecal excretions and moisture from the drinking system. Manure from cage-reared birds is usually kept in the pit or basement of a two-story building or piled separately when manure belts remove it from the bird's quarters. In the United Kingdom (U.K.), energy plants designed to burn poultry manure and litter generate 65.1 megawatts of electricity, enough to meet the needs of 65,100 households. The three plants in the U.K., centrally located in broiler- and turkey-growing regions, consume approximately 50% of the litter generated in these regions, restoring nutrient balance to equilibrium. After incineration, the potassium (K)- and P-rich ash fertilizer is concentrated into 10% of its original weight and 5% of its original volume, making it easy to transport the nutrients to where they are actually needed. In the U.K., the government subsidizes the price of electricity generated from renewable sources such as poultry litter through a "green power" subsidy (Fraser 1998). Others have shown that poultry and animal wastes can be held in anaerobic tanks while digesting bacteria produce a biogas rich in methane. The methane is then combusted in an engine to produce electricity. Both the residual ash from incineration and the solids remaining after anaerobic digestion have feeding value for poultry or livestock.

Because poultry manure and litter are rich sources of nutrients for plants, they also have significant feeding value for cattle and other ruminants. Microorganisms in a cow's rumen can utilize the N and fiber in litter to make proteins and fatty acids for growth or production. The litter is also a rich source of Ca and P for bones and other metabolic processes. The feeding value of dried litter in cattle feeding tables includes 64% total digestible nutrients (TDN), 26% crude protein (CP), and 18% crude fiber (CF). Dried poultry manure contains 54% TDN, and 28 and 13% CP and CF, respectively. Beef cows can be wintered with ration mixtures of 80% broiler litter and 20% ground corn or other palatable concentrate. A small amount of hay or other forage should be fed for normal digestion and health (Collins et al. 1999). These methods of recycling poultry litter nutrients to ruminants are not utilized to their fullest extent.

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The primary value of poultry manure and litter continues to be as a source of plant nutrients for growing crops and forages despite the opportunity to recycle manure energy and nutrients as either a fuel or feedstuff for livestock. Consider a hypothetical poultry farm with 100,000 laying hens and 164 arable acres for corn production. In Pennsylvania, this farm has the threshold number of acres with two (1,000 lb) animal equivalent units per acre; otherwise, it would be considered a concentrated animal operation and require a nutrient management plan. Based on field research with commercial hens (Patterson and Lorenz 1996), the following balance of nutrients would result if all manure were spread on 164 acres available for corn (Table 11-1). Manure nutrients would exceed nutrient removal by the grain at a yield of 150 bushels/acre . Hen manure total N would exceed crop removal by 2.5 times, P_2O_5 by 8.5 times, and K_2O by 6.5 times. Although other crops would better use the nutrients produced by the hens, the example addresses the challenges of balancing farm nutrients when only a limited land area for spreading manure is available. In this lesson, "fecal nutrients" from birds refers to nutrients from feces and urine as both are voided together from the cloaca.

Although the nutrient density of poultry manure may appear to be easily reduced by simple measures such as adding dietary enzymes or cutting dietary protein or P levels, the requirements and relationships of nutrients with feed ingredients are complex. Dietary protein, certain amino acids, P, and trace minerals are essential nutrients for poultry and must be provided in the bird's diet. Failure to provide adequate levels of these nutrients would be physiologically and economically unacceptable. However, there may be opportunities to more precisely meet the bird's requirement depending on current dietary levels and any margin of safety additions. The following discussion outlines dietary and management strategies aimed at nutrient reduction.

Table 11-1. Manure and nutrients produced by 100,000 commercial laying hens annually and nutrients removed by corn grain at 150 bushels per acre.

Manure Nutrients, lbs[a]		Nutrients, lbs/acre[b]	Nutrients Removed by Corn Grain[c]	Nutrients in Manure/Nutrients Removed by Corn
Total N	53,650	328	130	2.5X
P_2O_5	79,120	483	57	8.5X
K_2O	44,630	272	42	6.5X

[a] 100,000 hens produce 2,776,860 lbs, or 1,388 tons of manure annually. Source: Patterson and Lorenz 1996.
[b] 164 acres of arable land to apply manure
[c] Martin et al. 1975.