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MANAGEMENT OF WASTE BY-PRODUCTS IN MEDIUM-SCALE COMMERCIAL POULTRY FACILITIES IN PERI-URBAN IBADAN, NIGERIA

Akintayo Oluremi*

Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria

Quainoo Jemimah

Federal College of Agriculture, Ibadan, Nigeria

*E-mail: oluremijayakint@gmail.com

ABSTRACT

Due to increasing human population in and around the city, it is important to pay attention to issues related to the environment and human health, especially poultry waste management towards environmental sustainability in peri-urban areas. The three waste by-products of primary concern in poultry production are the litter, the manure and dead birds common to all operations. With the aid of a pre-tested and validated questionnaire, data were obtained from forty poultry farmers whose medium-scale commercial facilities were located in peri-urban Ibadan, Nigeria and were selected through a multistage sampling technique. Eighty percent of the farmers regarded poultry waste by-products as useful and valuable resource while twenty percent regarded the wastes as nuisance that had to be disposed of. The predominant methods of poultry waste by-product disposal were burying of carcasses and litter, burning of carcasses, direct application of litter on crop farms and feed source for other livestock such as swine and fish. None of the farmers composted the wastes and none used them for bio-energy production. There was positive and significant correlation between farm operators' training and distance of farm to natural surface water ($r=0.621^*$, $p=0.031$). There is need for impact assessment studies on the effects of poultry facilities on the environment with particular reference to underground and surface waters.

KEY WORDS

Peri-urban, poultry, waste by-products, medium-scale.

Commercial peri-urban production of livestock has been noted to be an extremely fast-growing sector, representing 34 percent of total meat production and nearly 70 percent of egg production worldwide (Harlan, 2014). However, while this expansion in livestock particularly poultry in the peri-urban zones provides food and employment, it also raises issues related to pollution and food safety.

The poultry industry is one of the largest and fastest growing agro-based industries in the world (Bolan *et al*, 2010; Moreki and Chiripasi, 2011). One major feature of peri-urban poultry production is that it offers the comparative advantage of its location close to important consumers' concentrations (the urban population). This proximity to consumers' concentrations allows for saving on energy at various levels of the food chain, which is on packaging, transport, storage, and distribution, that will ultimately affect the final retail price of the food commodities (Harlan, 2014). It has been noted that global demand for dietary animal protein is rapidly increasing as a result of increased prosperity and urban population growth in developing and transition economies. However, the vast majority of the global demand for poultry products is in the form of chicken meat (Harlan, 2014). In order to meet this growing demand for poultry products, there is a responding growing/expanding poultry industry.

The normal day to day activities and processes of the poultry industry result in the production of poultry waste by-products. As poultry industry continues to expand, the need to address environmental issues become very critical. The operation of poultry facilities will always have environmental effects. However, the extent to which these effects are detrimental will depend on how the poultry operation is managed.

Poultry manure and litter have historically been used as a source of plant nutrients and soil amendment (Brake, 1992). Waste by-products such as excreta (manure) or bedding material such as sawdust and wood shaving (litter) that are generated by the worldwide annual production of more than 40 million metric tons of poultry meat and 600 billion eggs are generally applied to land as the final step of a producer's waste management strategy. Under proper land application conditions, the nutrients and organisms in poultry wastes pose little environmental threat (Williams *et al*, 1999; Williams, 2013). However, environmental contamination takes place when land application of poultry wastes is in excess of crop utilization potential, or is done under poor management conditions causing nutrient loss from environmental factors such as soil erosion or surface runoff during rainfall. Thus, depending on the waste management program, land application of poultry manure and litter can either be an economical and sound agricultural decision or an environmental hazard (Brake, 1992).

Due to increasing human population in and around the city, it is important to pay attention to issues related to the environment and human health. This makes it very important to give poultry waste management good considerations towards environmental sustainability in peri-urban areas. The three waste by-products of primary concern in poultry production are the litter, the manure and dead birds common to all operations.

Poultry production is on the increase in Nigeria (Kalu, 2015) and was observed to increase by 20% in 2013 (Alawode, 2013) with a corresponding increase in the population of chickens. According to Pagani *et al* (2008), the four sectors in Nigerian poultry production can be classified in terms of the scale of production as: Sector 1 - Commercial (more than 10,000 birds); Sector 2 - Medium-scale commercial (2,500 – 10,000 birds); Sector 3a - Small-scale commercial (500 – 2,500 birds); Sector 3b - Backyard (a few – 1,500 birds); Sector 4 - Rural (a few – 200 birds or more).

However, one aspect of poultry farm operations which has not kept pace with the bird population and intensity of production is waste management. Manure disposal has been noted to be a major constraint to the poultry production in Nigeria (Lawal *et al*, 2009; Oyeбанjo and Otunaiya, 2011). This is the case as manure is often considered waste material and a place to dispose them must be found. In a study by Oyeбанjo and Otunaiya (2011) carried out in Ogun state, Nigeria, it was found that poultry waste by-products were considered non useful by 63.9% of the poultry farmers. One of the recommendations of that study was the need for farmers to be educated on the conversion and utilization of poultry wastes/manure as organic fertilizer which can be made available to the numerous smallholder crop farmers to augment scarce and expensive inorganic fertilizers. Waste disposal and by-product management on poultry farms can pose problems in the areas of environmental sustainability and protection. Many of the practiced waste disposal methods are employed based on economical convenience, giving little or no consideration for environmental sustainability. This study was thus designed to examine the methods employed by medium-scale commercial poultry facilities in managing waste by-products from their operation in peri-urban Ibadan, Nigeria.

METHODS OF RESEARCH

Study area: This study was carried out in the peri-urban area of Ibadan, Nigeria. Ibadan (7° 23'N, 3° 56'E) is located in southwestern Nigeria 128 km inland northeast of Lagos and it is the capital city of Oyo state. With a population of over 3 million and a total area of 3,080km², it is also the largest metropolitan geographical area in Nigeria (Wikipedia, 2014). Administratively, Ibadan metropolitan area is made up of eleven local government areas comprising of five local government areas in the city and six semi-urban local government areas in the less city. The growth of the city built-up area has been noted in the last two decades to spread particularly to two local government areas (Akinyele and Egbeda local government areas) (Wikipedia, 2014).

The sampling procedure for this study is the multi-stage sampling technique. The first stage involved the purposive selection of Egbeda local government area in Ibadan as a result of the spread of growth of the city built-up area toward this area in the last two decades. The

second stage of sampling was the random selection of five out of the eleven wards from the local government area while the next stage involved the random selection of poultry farms from the selected five wards. A total of forty medium-scale commercial poultry farms were randomly selected from the selected five wards.

Data were collected with the aid of pre-tested and validated questionnaire which were administered to the farm owners of the selected poultry farms through interview schedules. Questions asked covered aspects of bird population, distance of natural water source to farm, distance of residential building to farm, method of waste disposal. Descriptive statistics such as percentages were used to describe responses from farmers while correlation analysis was used to determine relationships between variables.

RESULTS AND DISCUSSION

Population of birds raised by respondents ranged from 3,000 to 10,000 thus placing the farms in medium-scale commercial poultry production category.

Table 1 - General information on poultry farms

n/n	Percentage of poultry farms (%)
Bird population	
3,000-4,500	15
4,500-7,000	55
7,000-10,000	30
Years of farm operation	
1-5	5
6-10	10
11-15	50
Above 15	35
Distance from river/stream	
Less than 200m	25
200m-800m	10
900m-3000m	45
Above 3000m	20

Source: Field survey, 2014.

Majority (85%) of the farms had been existing and operating for more than ten years while 10% of the farms had been in operation for 6-10 years. Thus, these farms can be regarded as fully operational with production activities going on for more than six years. A poultry facility, irrespective of its size, is expected to consider and incorporate issues on the management of waste by-products at its planning and operation stages. Majority (75%) of the farmers indicated that they had waste management plans for their poultry facilities while 25% indicated that there was no existing waste management plan for their farms.

Method and cost of waste by-product disposal. To achieve environmentally and economically acceptable poultry waste management system, it is necessary to examine the available management options. There are many systems and approaches which can be successful if properly operated and maintained for poultry waste management. These include bio-energy production, animal re-feeding and land application of crop nutrients (Williams, 2013). Worldwide, among the many ways of disposing poultry wastes include composting, incineration, burial, fertilizer and feed for livestock.

Carcass disposal. With regard to bird carcasses (on-farm mortalities), results from this study reveal that 35% of the farmers buried bird carcasses while 15% burned the carcasses. However, some of the farmers (30%) fed the carcasses to pigs and or fish which they raise alongside poultry. Twenty per cent of the farmers sold their bird carcasses to other farmers who fed them to livestock.

Manure and litter disposal. When properly managed, the application of poultry manure or litter to land to enhance crop productivity is an effective and beneficial option of poultry waste management (Williams, 2013). However, only 10% of the farmers applied manure from their poultry facility to their crop land. Nevertheless, 45% of the farmers sold their

manure/litter to other crop farmers while 10% gave litter out to crop farmers who requested free of charge. Burial of litter was the option for 30% of the farmers who buried poultry litter in dug pits not more than five hundred metres (500 m) from poultry facility. None of the farmers utilized the manure and litter produced from their poultry operations for bio-energy production. The generation of heat/electricity from incineration of poultry waste by-products was also not done by any of the farmers.

With regards to the cost incurred for poultry waste disposal, most (70%) of the farmers indicated no cost incurrence as the disposal of wastes from daily operations was considered part of routine activities taken care of by workers on the facility. Thirty per cent of the farmers paid for the disposal of their poultry wastes as they employ labour from outside to carry out the clearing and cleaning processes.

Perceptions of waste by-products by farmers: If the manure/litter is considered as a by-product of certain processes, a possible use for it in a market economy can be found. We are at a time when emphasis is being laid on sustainable agricultural systems and value chains and so, it is necessary to emphasize the fact that what was considered a waste can be used in many varied, environmentally friendly ways to minimize environmental impact and waste. Majority (80%) of the poultry farmers considered the waste by-products from their facilities as useful material to serve as inputs in other farm enterprises while twenty percent of the farmers considered poultry waste by-products as nuisance to be discarded.

Location of surface waters (streams and rivers) in relation to poultry facilities: Environmental parameters of concern are Nitrogen, Phosphorus, and certain metals (Copper and Zinc in particular), as well as pathogenic microorganisms that may be contained in poultry waste. Elevated concentrations of $\text{NO}_3\text{-N}$ in groundwater used for human consumption is a health risk (Williams *et al*, 1999). Twenty-five percent of the poultry facilities were located within a range of less than 200 metres from streams/rivers. Ten percent of the farms were in the range of 200-800 metres from rivers/streams while forty-five percent were within the range of 900-3000 metres to stream/river and the remaining twenty percent of the farms had streams/river more than 3000 metres away from them. Burying of carcasses and manure/litter can have effects upon water quality especially in areas where the water table is high or location of surface water such as stream or river is nearby.

Relationships between variables. A Pearson product-moment correlation coefficient was computed to assess the relationship between the following variables: Farm operator's level of education – distance between farm and tarred road; Operator's perception of poultry by-products – method of carcass disposal; Operator's training – distance between farm and natural surface water.

There was a negative but significant correlation between the level of education of the farm operator and the distance between the poultry facility and tarred road ($r=-0.555^*$, $p=0.011$). This indicates that the higher the level of education of the farm operator, the shorter the distance between the poultry facility and the tarred road. This is of great importance as the closeness of a tarred road to the facility would enhance timely transportation/delivery of inputs such as feeds and medication and the movement of produce such as meat and eggs to the market.

The correlation between farm operators' perception of poultry by-products and method of carcass disposal was positive and significant ($r=0.500^*$, $p=0.025$). This implies that the higher the value of poultry carcass perceived by the operator, the better the method of disposal. Operators with a higher value perception did not bury or burn the carcasses, but rather used them as feed for livestock or sold them to other farmers.

There was also a positive and significant correlation between farm operators' training and distance from farm to natural surface water ($r=0.621^*$, $p=0.031$; correlation significance at 0.05 level [2-tailed]). Operators who had prior training in poultry farming had their facilities located further away from streams/rivers as compared to those who had no prior training. This shows the importance of knowledge through training as it affects location of poultry facilities in relation to natural water sources. The closer a poultry facility is to water source, the higher the likelihood of contamination from by-products of the poultry facility and the greater the health risk would be for people who consume such water.

CONCLUSION

Posed with the challenge of disposing increasing volumes of poultry litter/manure/wastes from an expanding poultry industry in peri-urban areas, environmental health issues are of great concern as a result of activities on these poultry farms. Although the impact of the activities of these farms on the environment are not presently known and documented, good environmental poultry waste management could play an important part in minimizing the impact of their operations on the environment.

The importance of training in relation to poultry farming cannot be over-emphasized as this would positively influence farmers' perception, planning and operations on the facility.

There is therefore need for impact assessment studies on the effects of poultry facilities on the environment with particular reference to underground and surface waters. There is also need for collaboration between environmental safety agencies and poultry farms for sustainability of the environment and good health of the peri-urban populace.

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