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Poultry Waste Management Practices and Policy Implications for Environmental Sustainability in Urban Areas of Osun State, Nigeria

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ABSTRACT

Effective waste management method is a panacea for a long-term productivity, growth and environmental sustainability of poultry enterprise. In view of this, this study examined the poultry waste management practices and makes policy prescriptions for sustainable poultry production in Osun State. Multi-stage sampling technique was employed for this study. Primary data were collected from eighty poultry farmers selected from four Local Government Areas in Osun State through structured questionnaires. The data were analyzed using descriptive analysis and multinomial logistic regression model. Result of descriptive analysis revealed that poultry production practice was male dominant, averaged 40 years old and attained tertiary education level with 15 years' experience in poultry production. Majority (88%) of the farmers were married with an average of four members per household. Statistics also revealed that farmers used deep litter housing system mostly with mean stocking density of 3,086 birds generating average of 5,001kg waste weekly. The waste generated was controlled by composting (46 %) and used mostly for organic manuring. Multinomial regression result shows that age of farmers, quantity of waste accumulated, household size and membership of associations were significant factors affecting waste disposal in the study area. Therefore, in order to overcome the waste management crises, conscience of poultry farmers needs to be raised through environmental awareness, imbibition of sustainable farming practices, and education on waste management.

Key words: composting, manure, multinomial logit, nutrients, pollution, waste disposal

INTRODUCTION

The increasing growth of poultry industry in Nigerian cities in the recent time has resulted in increased waste accumulation most importantly of litters and manures with the resultant environmental impacts (Adeoye *et al.,* 2014; Onu *et al.,* 2015). These wastes are by-products of feed items (droppings), dead birds (on-farm mortalities), hatchery wastes, litters (bedding materials including wood shavings, sawdust, straw, rice hulls or peanut), offal (slaughtered birds' visceral, feathers, and entrails), processing waste water and bio-solids generated during and after production periods (Charles, 2008; Moreki and Keaikitse, 2013; Onu *et al.,* 2015). Poultry waste contains some essential nutrients for plant growth including micronutrients and trace elements (Chan *et al.,* 2008). It also contains pathogens, hormones, antibiotics and heavy metals (Kalu *et al*., 2016). These ammonium salts, greenhouse gases and residuals of microbial synthesis can pose huge environmental challenges such as polluting the surface and ground waters if not properly managed (Idowu and Otuniaya, 2002; FAO, 2006; Ayodeji *et al.,* 2011; Adeoye *et al.,* 2014).

Aside its richness in essential plant nutrients, poultry waste is used in the formulation of livestock feeds and raw material substrates for bio-gas production (Idowu and Otuniaya, 2002). In the small-scale farms, maggots in the poultry wastes are fed to fish to reduce feed cost and increase yield gain in fish (Idowu and Otuniaya, 2002; Ayodeji, *et al*., 2011). However, this process must be well managed to eliminate the potential danger that can be caused to the lives of aquatic organisms (Moreki and Chiripasi 2011; Adeoye *et al.*, 2014). According to Idowu and Otuniaya (2002), less than 10 per cent of poultry wastes are recycled in feed stuffs in Nigeria despite the multiple importance and uses. Studies have shown that poultry waste management follows the same practice across most African countries (Mijinyawa and Dlamini, 2006; Ayodeji *et al.,* 2011; Moreki and Keaikitse, 2013; Adeoye *et al.*, 2014). For instance, reports have it that dumping on nearby wasteland or flushing into pit or nearby streams are the most common waste management practices while a few farmers practice composting in the Nigerian and Botswanan cities (Ayodeji *et al.,* 2011; Moreki and Keaikitse, 2013). This is done to save cost and thus resulted

into soil, water and air pollutions (Idowu and Otuniaya, 2002). In Ghana, however, environmental policy of Integrated Waste Management (IWM) has evolved and is slowly becoming an accepted practice (Cofie and Drechsel, 2005; Adedayo., 2012). This practice ever remains the most environmentally friendly approach to waste management (McAllister, 2015). Through IWM, community participations, independent organizations and government bodies are encouraged and environmental citizenship is engendered among the community members (McAllister, 2015).

The rate of waste generation and nutrient contents of poultry waste production are affected by a number of factors. These include flock size and type, poultry stocking density, moisture content, feed type and frequency of application per day (Adedayo, 2012; Adeoye *et al.,* 2014). Nature and amount of bedding materials, litter management plan and strategy, manure collection frequency and ventilation level can as well affect poultry waste accumulation (Charles, 2008; Adeoye *et al.,* 2014). The choice of disposal techniques used by farmers is therefore dependent on climatic condition, regional location, poultry housing design, and size of birds in the farm (Charles, 2008) as well as socio-economic characteristics of the operating farmers (Idowu and Otuniaya, 2002; Adedayo, 2012; Ojewale, 2014).

Statement of the Problem

Poultry wastes in Nigeria have not been properly managed owing to several factors including ignorance, lack of technical knowledge, high cost of management, unavailability of appropriate technology, and lack of policy initiatives (Idowu and Otuniaya, 2002; Adedayo, 2012; Adeoye *et al.,* 2014**;** McAllister, 2015). Some of the major environmental policies vital to the establishment of poultry farms in Nigeria as adopted from the principles of Agenda 21, agreed in Rio in 1992 are the regulations for the location of farms in the urban communities, safer recovery of wastes and promotion of sustainable waste management pattern that are environmentally sound (UNEP, 2004; Adedayo, 2012). These environmentally friendly policies have received low compliance among the poultry producers, consequent on the rapid expansion of urban small and medium scale poultry farms that are induced by population meat demands and increased agribusiness awareness in Nigeria. In so doing, the physical and economic developments of the host community are affected resulting into huge private and social costs to the individuals and the entire nation.

The existing disposal methods for poultry waste in Nigerian cities are neither cost effective nor environment friendly (Adeoye *et al,* 2014; Kalu *et al.,* 2016). Cofie and Drechsel (2005) and Charles (2008) argued that outright dumping of animal droppings on the ground surface or sub-surface can contaminate the ground water and surrounding water bodies with toxic elements (such as nitrogen, phosphorus, copper and zinc) and pathogens through leaching and erosion unless a proper check is practiced (riparian buffering). Similarly, animal droppings are arguably powerful to cause soil and air pollutions if the agronomic uptake of the receiving crop is less than the nutrient deposits (Cofie and Drechsel, 2005; Charles, 2008). And the choice of disposal technique varies from farmer to farmer as well as regions (Charles, 2008). Therefore, issues related to the environment, human health, potential income gain and the quality of life for the poultry farmers as well as the people living near to and distant from urban poultry production operations make waste management a critical consideration for the long-term growth and sustainability of poultry production. Given the large volume of poultry waste that is produced on farms and the needs for their disposal, it is highly imperative to assess the methods of waste disposal in urban poultry farms and determines the corresponding determinants of choice of waste disposal methods practice with a view to providing policy options for environmental sustainability.

MATERIALS AND METHODS

The study was carried out in Osun State, Nigeria. The state is located in South-Western Nigeria. Osun State has interstate boundaries with Kwara State to the North, Ekiti State to the North-East, Ondo State to the South –East, Ogun State to the South-West, and Oyo State to the West with the State capital in Osogbo. Lying within Latitude 7.0^{o} and 9^{o}N and Longitude 4.50 - 6.80^{o}E, Osun State covers a land area of 9,251 square km. The state population is 3,423,536 persons with a population density of 379 people/sq. km (NPC, 2006). The state has thirty Local Government Areas (LGAs) constituted into three senatorial districts - Osun Central, East and North with derived savannah and rain forest belt vegetation. The state commands fair concentration of poultry production in the urban area. Multi-stage sampling technique was employed for this study. First stage involved the purposive selection of four LGAs out of the thirty LGAs in the state due to the high concentration of poultry farmers in the areas. Osogbo, Atakunmosa West, Iwo and Ife Central were chosen. Second stage involved a purposive selection of one urban community with the highest population of poultry farms in each of the four LGAs. So, Osogbo, Ilesha, Iwo and Ile-Ife were chosen. And lastly, a random selection of twenty poultry farms from each of the towns was done to make a total of eighty respondents.

Primary data were collected for this study using a structured questionnaires and interview schedules. Information that bothers on poultry wastes management techniques and

implications on the environment were collected from the respondents. Data collected includes demographic information such as age, gender, marital status, years of formal education, and household size. Information were also obtained on the production data such as poultry farm scale, type of poultry farm housing system, type of poultry bird raised, stocking density, types and sizes of poultry waste generated, and waste disposal method employed by farmers. Descriptive analysis was used to describe farms' and farmers' socio-economic characteristics; examine the type and quantities of waste generated in poultry production and the various waste management strategies that are employed by poultry farmers. Multinomial logistic regression was employed to analyse the determinants of waste management method used by poultry famers.

Analytical technique: Multinomial Logistic Regression Model (MLRM)

The acts of providing explanation to a given choice among a set of exclusive alternative of binary outcomes can be statistically addressed by the use of multivariate discriminant and multinomial logistic regression models (MLRM) (Maddala, 1983; Green 1997; Ojewale, 2014; Statistic solution, 2017). The difference between these two methods is in the assumptions associated with both tests (Long, 1997; Green 1997). If the data is not multivariate normal, both the variance and covariance are heteroscedastic and the independent variables are non-linearly related therefore; a logistic model will be most appropriate (Long, 1997; Statistic solution, 2017).

The basic idea behind logistic model is the use of a logarithmic function to linearize a non-normally distributed endogenous dataset and then restrict the probability values to (0, 1). This approach is technically known as the logarithm of the odds of y = 1. The MLR Model has outcome variables with binary options (0, 1) each, which is mutually exclusive to one another. Multinomial logistic technique employs the use Relative Risk Ratio (RRR) or Conditional Odd Ratio (COR) approach to account for the likelihoods of the restricted models and the log odds of the other possible outcomes (Long, 1997; Sharyn, 2015). Conventionally, the estimations of RRR or COR for unordered outcomes require the use of base category for comparison (Long, 1997). All the coefficients of this category are forced to zero as a necessary condition to report unique estimates of the betas (Sharyn, 2015; Matt, 2016). According to Long (1997), the estimated coefficients from logistic regression are not easily interpretable but odd ratio can provide better interpretations and meanings. In MLRM, irrelevant alternatives are assumed independent of the choice alternative and therefore, are considered constant (Long, 1997). This mean that factors relating to one alternative does not necessarily affect the odds of choosing another alternative even in the case of alternatives of closer substitutes in comparison to a third alternative. The change in attractiveness of one of the two closely substituting alternatives would be predicted to leave the relative probabilities of choosing a close substitute choice relative to the third alternative unchanged.

According to Maddala (1983), MLRM is based on McFadden utility model (U) which is

$$Y_i^j = \alpha' x_i^j + \gamma'_j a_j + \varepsilon_i^j = \beta_j' z_i^j + \varepsilon_i^j = Y_i^{-j} + \varepsilon_i^j \quad (j = 1\ldots m) \ldots\ldots\ldots (1)$$

Where $\boldsymbol{Y_i^j}$ is the derivable utility, x, a and z are the predictor variables, α and β_j' are the parameters, while ε_i^j is the error term.

Given a response variable Y_i with outcome categories (k) indexed by i=1, 2, 3…k. The category (i) has a relative probability (P_r) of

$$P\_r\ [Y\_i\ ] \sim \exp(\beta\_1\hat{}((i)\ )\ X\_i + \cdots + \beta\_m\ X\_m) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where parameter $\beta_1^{(i)}$ is the parameter to be estimated and Y_i for $P_r[Y = category\ 1]$. Normalizing the equation to make this relative probability sum to unity gives

$$P_r[Y_i] = \frac{p_i(X,\beta)}{p_i(X,\beta) + \cdots + p_m(X,\beta)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

For the base category, taking derivatives (∂) with respect to the m-th predictor in equation (3), a marginal rate of change of the log odds for a category (i) with respect to the baseline category for the independent variables (X_j) is obtained as

$$\frac{\partial \log odds(Y_i)}{\partial(X_i)} = \beta_j^{(i)} - \frac{\beta_j^{(i)} P_i + \cdots + \beta_j^{(i-1)} P_{i-1} + \beta_j^{(i+1)} P_{i+1} + \cdots + \beta_j^{(k)} P_k}{P_i + \cdots + P_{1-1} + P_{i+1} + \cdots + P_k} \ldots (4)$$

Where $a_i = 0$ when j is the baseline or reference outcome.

This study therefore operationalized the exclusive determinants of the choice of poultry waste disposal method in terms of Multinomial Logistic Model (Ojewale, 2014). The method of disposal was taken as the dependent variable and farms' and farmers' socio-economic characteristics as independent variables (X_i). The dependent variables were discrete variables taking values 1, 2, 3, 4 for cases of identified disposal methods while U is the utility derived from the choice of disposal method employed.

Farmer's choice of disposal method (U) is specified as a linear function of the farmer's specific characteristics, and

the attributes of the farm (X) as shown in the equations below:

$$U \text{ (method of disposal I)} = \beta_i X_i + e_i \ldots\ldots\ldots \quad (5)$$
$$U \text{ (method of disposal J)} = \beta_i X_i + e_i \ldots\ldots\ldots \quad (6)$$
$$U \text{ (method of disposal K)} = \beta_i X_i + e_i \ldots\ldots\ldots \quad (7)$$
$$U \text{ (method of disposal L)} = \beta_i X_i + e_i \ldots\ldots\ldots \quad (8)$$

The method of disposal (dependent variable) = chosen method of disposal I, J, K, L and if U (Method of disposal I) > U (Method of disposal J) > U (Method of disposal K) > U (Method of disposal L) then,

$$I \neq J,\ I \neq K,\ J \neq L \text{ and } K \neq L \ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

Therefore,

$$B_i X_0 + e_i > = \beta_j X_0 + e_j > \beta_k X_0 + e_k > \beta_l X_0 + e_l \ldots \quad (10)$$

Where U is the utility derived from the choice of disposal methods I, J, K and L. β is the coefficient of the independent variable X. Explicitly,

$$Ui = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + e_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

Where:

Ui=Method of disposal (1= burial, 2 = burning, 3 = composting, 4 = flushing)
X_1= Stocking density (number)
X_2 = Age (years)
X_3 = Extension visits (frequency)
X_4 = Quantities of waste (kg)
X_5 = Household size (number)
X_6 = Sex (male = 1; female = 0)
X_7= Poultry Farming Association (if yes = 1; otherwise = 0)
e_i= disturbance error

where burial method was taken as baseline disposal method.

RESULTS AND DISCUSSION

Socio-economics characteristics of poultry farmers

Poultry farmers had a mean age of 42±11 years (Table 1). This implies that majority of the poultry farmers were physically strong, and in their economic and active age and hence, are more likely to manage poultry waste properly. This finding agreed with Olumayowa and Otunaiya (2011) that poultry farmers are mainly middle-aged people. Majority (84%) of the respondents were male which indicated existence of gender inequality in poultry production. This finding is corroborated by the submission of Olumayowa and Otunaiya (2011) that poultry production is male dominant probably because its operations requires physical strength that can be provided by men alone. Similarly, more than three-quarters (89%) of the respondents were married, with average household size of 5±2 members per household. This is an indication that the respondents had moderate household size which could serve as family labour supply in the management of poultry wastes.

According to Olumayowa and Otunaiya (2011), household size influences the possible number of labour readily available to individual poultry farmer. In addition, more than three-quarter of the respondents had tertiary education. This knowledge, if well harnessed, can induce effective waste management in poultry production. Table 1 also reveals that majority (88.7%) of the poultry farmers engaged in commercial while 11.3% were involved in subsistence poultry farming. This implies that poultry farms in the study area were mainly business entities for profit making. The result also showed that poultry farms have been operated by the farmers for an average of 11.48±9.4 years. In all, about 43.0% of the farmers have been in the business for a period of 6 to 15 years while 35.0% had less than 5 years' poultry experience. Aside from poultry, these farmers engaged in other farm enterprises (62.5%). This suggests possible alternative uses for poultry litters and manures rather than causing wastes' pile-up and environmental pollution in the neighbourhood. This result is supported by Akanni and Benson (2014). Moreover, the result showed that poultry farmers were socially inclusive. About three-quarters (77.5%) of the respondents were members of the poultry farmers' associations while 22.5% were not. Involvement in poultry farmers' associations could help in the acquisition of relevant information in form of trainings and seminars that could enhance proper management of poultry waste. These farms are reported to have been visited by the extension agents (63.8%) and thereby shows access to extension services where tips on effective poultry waste disposal could be obtained. Deep litter housing system was most prevalent among the poultry farmers (68.7%) meanwhile, the use of battery cage system (18.7%) was not well pronounced. Majority (56.2%) of the farmers raised broilers followed by layers (18.8%) and then combination of broilers and layers (17.5%). This finding is in line with that of Moreki and Keaikitse (2013) but differed from that of Kalu *et al.,* (2016) who claimed that layers production is most prevalent among poultry farmers. In terms of stock size, poultry farmers had average of 3,086±2,632 birds in which not more than 2,000 birds were raised by 53.8% while 26.3% of the farmers raised between 2,001 and 4,000 birds. This showed that most of the poultry farms in Osun State were small scales. It is therefore expected that farmers should be able to control poultry wastes due to low stock size. This finding is supported by Olumayowa and Otunaiya (2011) that 78% of the farmers reared less than 5,000 birds.

Table 1: Socio-economic characteristics of poultry farmers in the study areas

Variable	Frequency	Percentages	Mean	Standard deviation
Age (years)				
Below 30	12	15		
31 – 40	30	37.5	41.84	11
41 – 50	20	25		
51 – 60	14	17.5		
Above 60	4	5		
Sex				
Male	67	83.8		
Female	13	16.3		
Marital status				
Single	9	11.3		
Married	71	88.8		
Household size				
<= 3	20	25		
4 – 6	49	61.2	4.74	1.98
7 – 9	9	11.3		
10+	2	2.5		
Educational qualification				
No formal education	1	1.3		
Primary	3	3.8	14.77	3.99
Secondary	12	15		
Tertiary	64	80		
Mode of operation				
Subsistence	9	11.3		
Commercial	71	88.7		
Farming experience (years)				
≤5	28	35		
6-15	34	42.5	11.48	9.39
16-25	12	15		
25+	6	7.5		
Other farm enterprises				
Yes	50	62.5		
No	30	37.5		
Membership of poultry association				
Yes	62	77.5		
No	18	22.5		
Access to extension service				
Yes	51	63.8		
No	29	36.2		
Housing type				
Battery cage	15	18.7		
Deep litter	55	68.7		
Both	3	3.8		
Free range	7	8.8		
Types of poultry birds raised				
Broiler	45	56.2		
Layers	15	18.8		
Broilers and layers	14	17.5		
Broiler, layer, turkey, cockerel	6	7.5		
Stock size (birds)				
≤ 2,000	43	53.8		
2,001 – 4,000	21	26.2		
4,001 – 6,000	6	7.5	3,086	2631.65
6,001 +	10	12.5		

(Source: Field Survey, 2015)

Poultry Waste Management Practices

Table 2 shows that on the average, the quantity of wastes generated in the poultry farms was estimated to be about 5.26±3.47 metric tons/week (5,260±3,470kg/week). In general, 27.5% of the respondents generated waste between 4.01-6.00 metric tonnes/week, followed by 22.5% that generated waste between 2.10-4.00 metric tonnes/week. This finding further proved that poultry waste could be cumbersome to manage in the study area and agreed with findings by Adeoye *et al.* (2014). In terms of disposal method, wastes are gotten rid through composting (46.3%), followed by burning (32.5%), then burial (16.2%). The result is a strong indication that composting is receiving due acceptance among urban poultry farmers in the study area. A similar finding is reported by Moreki and Keaikitse (2013) in Botswana however, report by Adeoye *et al.* (2014) in the northern part of Nigeria proved otherwise. The reasons for the chosen methods of disposal were mainly attributed to availability and convenience (32.4%), agricultural use (28.8%), prevention of pollution and disease outbreak (27.5%).

Table 2: Methods of waste disposal in poultry farms in the study areas

Variable	Frequency	Percentages	Mean	Standard deviation
Quantity of waste generated (tonnes/week)				
<= 2.00	15	18.7		
2.10 – 4.00	18	22.5		
4.10 – 6.00	22	27.5	5.26	3.47
6.10 – 8.00	8	10		
8.10 – 10.0	8	10		
10.10 +	9	11.3		
Methods of waste disposal				
Burial	13	16.2		
Burning	26	32.5		
Composting	37	46.3		
Flushing to collection tank	4	5		
Reasons for the chosen method				
Availability and convenience	26	32.4		
Manuring	23	28.8		
Prevent pollution and disease outbreak	22	27.5		
Time, space and Transportation problem	9	11.3		
Methods of waste utilization				
Biogas and power generation	7	8.8		
To control erosion	2	2.5		
Organic manuring	47	58.8		
No use	16	20		
Supplement in fish feed such as maggot	8	10		
Ways of controlling odours				
None	21	26.3		
Proper routine management	19	23.8		
Outright burning	12	15.3		
Use of Chemicals	11	13.8		
Timely packing of waste	10	12.5		
Disposed far from residence	7	8.3		
Methods of waste collection				
Manual scrapping with shovel	68	85		
Slopped floor system	11	13.8		
Flushing	1	1.3		
Frequency of waste disposal				
Daily	7	8.8		
Weekly	36	45		
Fortnightly	18	22.5		
Monthly	19	23.7		

Source: Field Survey, 2015

Majority (58.8%) of the farmers converted wastes to organic manure for growing crops. The finding supports reports by Onu *et al.,* (2015) and Mijinyawa and Dlamini, (2006) that majority of poultry farms recycle wastes as farm yard manure for crop production. This is an implication that majority of poultry farmers earn additional values from utilization of poultry wastes. This finding is in agreement with the study by Adedayo (2012) that manure from poultry wastes reduced complete dependence on inorganic fertilizers for soil fertility among the urban farmers. About 10 per cent of the respondents used maggots from poultry wastes to supplement fish feeds while 8.7 per cent converted waste to biogas and power generation. However, about 20 per cent of the farmers did not put poultry wastes into any use. For the control of odour emanating from the poultry wastes, about 26 per cent of the poultry farmers did not control the odour, followed by 24.0 per cent that used the proper routine management practices such as the avoidance of water spillage and regular packing of wastes, 15 per cent practiced outright burning of wastes, 14 per cent used chemicals, while a minority (8.3%) disposed wastes far from residence to the waste sites. These wastes are removed mainly by manual scrapping with shovel (85.0%) and slopped floor system (13.8%). This study agrees with Adeoye *et al.* (2014) and Mijinyawa and Dlamini, (2006) that poultry waste disposal is not technologically inclined in Nigeria and Swaziland respectively. Majority (45.0%) of the farmers were in the habit of changing poultry wastes weekly, some other farmers changed wastes fortnightly (22.5%) and monthly (23.7%) respectively. This means that despite the low quantity of wastes generation, poultry farmers could not maintain daily clearing of poultry house. The study agreed with findings by Kalu *et al.* (2016) and Adeoye *et al.* (2014). According to Anosike (2007), daily removal of waste is essential to hygienic and healthy environment in poultry production. It is therefore imperative that necessary actions are taken to ensure that poultry farmers in Osun State comply strictly with the given regulations on the management of poultry wastes.

Determinants of Choice of Waste Disposal Methods

Multinomial logistic regression result in Table 3 shows that the model was statistically significant. The model had a chi-square value of 43.63 and a log likelihood of -71.54. The possibility that the variations in the dependent variable is not by chance is significant at $P<0.01$, confirming the appropriateness of the specified model.

According to the regression result, four variables were reported to significantly affect waste disposal method. These are age, quantities of waste generated in kilogram, household size, and poultry association. In agreement to the "*a priori expectation*", poultry association was statistically significant at 5% but negatively related to the method of disposal. The result indicates that if an additional one poultry farmer joins the poultry farming associations, farmers will less likely prefer burning to burial method as a waste disposal method by three times (3.073). In other words, an increase in the membership of poultry farming association by one member will more likely reduce the chance of practicing burning as a waste disposal method by 3 folds than burial method. The result agreed with findings by Adeoye *et al.* (2014).

Similarly, contrary to the *"a priori expectation",* Quantity of waste generated (tonnes) was also statistically significant at 10% and negatively related to disposal methods. This implies that an increase of 1 tonne in the poultry farms' waste accumulations may less likely make farmers to prefer composting and flushing to burial as disposal methods and thus decreases the chance of using composting (0.0004) and flushing (0.0017) slightly less than that of burial method. This means that large waste generation may hinder the practice of composting and flushing disposal methods among poultry producers. By implications, increase in waste accumulation makes waste management cumbersome and as a result, poultry farmers may decide to bury wastes instead of flushing or composting them for the production of manure and bio-gas. This has gross economic and environmental implications (Charles, 2008). The practice of waste flushing has been condemned due to the resultant negative impacts on the aquatic environment (Charles, 2008; Moreki and Chiripasi 2011; McAllister, 2015). It is therefore important that efforts are made to educate farmers on the potential income earning capacity of poultry wastes most importantly in this age of production boost.

Household size was statistically significant at 10% and positively related to disposal methods. The result showed that an increase in the household size by a member will lead to more likely preferences for composting (36.4%) and flushing (187.3%) as against burial disposal method which was the base outcome. This could be attributed to larger household size which provides readily available family labours for the packing and transportation of the waste for composting. In addition, in line with the "*a priori expectation*", Age of the farmer was statistically significant at 10% but negatively related to waste disposal method. The result indicates that as the farmers grow older by a year, they will less likely prefer flushing to burial method. This may be due to the vigorous work involved in flushing. In other words, as farmers grow older, their chances of using flushing as a disposal method will be decreased by 40.6%. This finding agrees with Adedayo (2012) who discovered a correlation between waste management method and age of farmers.

Table 3: Maximum Likelihood Estimates of Multinomial Logistic Regression for Determinants of the Poultry Waste Disposal Method

Variables	Burning			Composting			Flushing		
	Coefficients	**Std. Errors**	**p-values**	**Coefficients**	**Std. Errors**	**p-values**	**Coefficients**	**Std. Errors**	**p-values**
Stocking density	0.0004866	0.0003786	0.199	0.0002738	0.0002839	0.335	0.0021327	0.0014079	0.13
Age	-0.0369837	0.0495396	0.455	-0.0165011	0.0352025	0.639	-.4060223*	0.240783	0.092
Extension visits	-0.2399093	0.3453048	0.487	-0.1654801	0.23345	0.478	-5.398625	5.410088	0.318
Quantities of waste	-0.0003468	0.0002899	0.232	-.0003884*	0.0002181	0.075	-.0017106*	0.0009697	0.078
Household size	0.0763118	0.2845676	0.789	.364708*	0.220228	0.098	1.872562*	1.087706	0.085
Sex	-0.573958	1.065158	0.59	0.2461699	0.7841868	0.754	17.37729	1420.96	0.99
Poultry Association	-3.072999**	1.32547	0.02	-1.12925	1.206544	0.349	-2.655055	2.141644	0.215
Constant	4.073097	2.156693	0.059	1.721926	1.728167	0.319	-6.748841	1420.962	0.996
Diagnostic Test									
Chi square	43.63								
Prob>chi²	0.0026***								
Pseudo R²	0.2337								
Log likelihood	-71.54								

Source: Data Analysis, 2015. Note: Level of Significance, *** Significant at 1%, **Significant at 5%, *Significant at 10%

CONCLUSION

It is evident that waste management practices in Nigerian have remained rudimentarily poor and practically abysmal despite the increasing global trends in integrated practices. This situation has been attributed mainly to the underlying existence of socio-economic differentials in the preference for waste disposal methods, regulatory negligence and lack of technical capability and innovativeness among the poultry farmers. It is therefore imperative that effective monitoring services are operated in the poultry sector. In addition, poultry farmers should be well sensitized on the need for waste management practices that are environmentally friendly, and that can reduce environmental pollution and incidence of disease outbreak. In view of this, collaborative efforts involving the community leaders, government monitoring groups and law enforcement agents should be put in place to realize the practice of integrated waste management in Nigeria. Poultry farmers should also be empowered to be able to make additional income from poultry wastes through bio-gas production. Thereby, the sustainable environmental safety policy that put emphasis on integrated poultry management would be embraced among the Nigerian poultry sector and put to practice by poultry farmers.

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