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GENDER ASSESSMENT OF POULTRY WASTE UTILISATION AMONG SMALL-SCALE POULTRY FARMERS IN OSUN STATE, NIGERIA: EXPLORING THE UNTAPPED POTENTIALS

Faborode HFB[1]*

Helen FB Faborode

*Corresponding author email: hfbfaborode@yahoo.com

[1]Department of Agricultural Extension and Rural Development, Obafemi Awolowo University, Ile-Ife P. M. B 013, Osun State, Nigeria

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ABSTRACT

Many researchers have worked on management of waste for sustainable livestock farming. However, focusing on gender in relation to the potentials of the enormous waste has not received adequate attention. Thus, this study focused on gender assessment of poultry waste utilisation in order to explore its potentials for promoting gender equity in rural livelihood options. The paper describes the socio-economic characteristics of male and female poultry farmers, identifies the waste and their uses, examines farmers' awareness of the uses, utilisation of poultry waste and explores its potentials across countries. A multi-stage sampling procedure was used to select small-scale poultry farmers from two Local Government Areas (LGAs) in Osun State based on the preponderance of poultry farms in the area. Snowball sampling technique was used to locate 120 poultry farmers and 20 key informants. Secondary data, interview schedule and guide were used for data collection. Data were subjected to descriptive and inferential statistics. Results revealed among others that more male were involved in poultry production with small holding flock size. Both male and female farmers had high awareness on the uses of poultry waste, yet utilisation was low. The results of Chi-square analysis showed that sex (χ^2 = 49.27; df = 1), level of education (χ^2 = 5.853; df = 2) and primary occupation (χ^2 = 121.181; df = 5) were related to poultry waste utilisation while years of experience (r=0.654), flock size (r=0.372), farmers' age (r=-0.365) and income from poultry production (r=-0.237) were significantly related to poultry waste utilisation. Significant difference (F = 8.893; df = 1; $p<0.05$) exists between male and female levels of poultry waste utilisation. It was concluded that utilisation of poultry waste by male and female farmers was low despite its enormous potentials. Therefore, training intervention with gender consideration is imperative to enhance poultry waste utilization.

Key words: Small-scale farmers, poultry waste, utilisation, gender equity, potentials, livelihood options

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INTRODUCTION

In Nigeria, livestock is an important sub-sector in agriculture, contributing significantly (10.3 %) to the nation's gross domestic product and enhancing household food security [1, 2]. Traditionally, gender is crucial in livestock production system with regional variations in ownership of livestock between men and women; largely dictated by socio-cultural and economic factors [3]. In many societies, cattle and other large animals are owned, managed and controlled mainly by men while smaller ones including backyard poultry are mainly for women [4]. Globally, the poultry industry has become one of the fastest growing and most commercialised livestock sub-sector [5]. Nigeria is no exception with poultry production largely dominated by the small and medium-scale farmers experiencing tremendous growth and contributing immensely (43.37 %) to the Agricultural sector [6].

It traditionally provides unrestricted access for women to participate in production throughout the year, playing dominant roles in poultry farming and often in control of the whole process including opportunity of making decisions on how the proceeds are spent which is not common in other livestock species. Therefore, poultry production provides an entry point for promoting gender equity in access to rural livelihood options. Consequent to the upsurge in poultry production, two major challenges emerged. The first is gender gap in access to livelihood options in favour of the male while the second is the huge quantity of waste generated. The traditional domain of women in poultry keeping is undergoing a shift in roles and attitudes [3]. While the men are having better access to improved production technologies and practices, the women continue to engage mostly in backyard poultry production system characterised by relatively low production. With gender gap in access to rural livelihood options, poverty among rural women in Nigeria may increase if no action is taken.
Apart from the gender gap, the phenomenal growth in poultry production and consumption has generated huge quantity of waste. Poultry wastes are defined as inedible materials generated along the production chain which may no longer be useful and need to be properly disposed [7]. The poultry wastes include litter, dead birds, broken eggs, eggshells, excreta and feathers and consequentially intensified disposal problem [8, 9]. Today the world is faced with the challenge of managing waste across nations and some of the most common poultry waste management practices in Nigeria and in most developing countries include dumping of waste on land surface, landfilling and channelling to water courses which pollute air and land as well as surface and ground water with widespread associated risks [10].

Thus, researchers have investigated the possible use of poultry waste generated to promote a sustainable crop-livestock farming system. Sustainable production is one important means by which the negative impact of animal food production on the environment is minimised. For instance, the use of poultry litter, including excreta, bedding (sawdust, wood shavings), spilled feed, feathers and dead birds as cheap source of protein in the diets of growing-finishing pigs and in ruminant rations in Egypt produced no deleterious effect on performance [11, 12]. Similarly, poultry waste is used for making economically viable by-products such as organic fertilizers, biogas and fish feed [12, 13, 14]. While much has been done to promote sustainable crop-livestock

production, little has been undertaken to bridge the gender gap in poultry production despite available outcome of research results with enormous untapped business potentials. The need to sustain the present tempo in poultry production without compromising gender equity informed the need to explore available options for utilising poultry waste among small-scale poultry farmers in Osun State. This paper describes the socio-economic characteristics of male and female poultry farmers, identifies the waste generated, their uses, examines the awareness, utilisation of poultry waste, constraints experienced by farmers and the potentials of poultry waste across countries.

MATERIALS AND METHODS

Study area, sample size and sampling technique

The study was conducted in Osun State, South Western Nigeria. A multi-stage random sampling procedure was used to select small-scale poultry farmers. At the first stage, six and four communities were purposively selected from each of the two Local Government Areas (LGAs): Ife East and Central, respectively to make a total of ten communities based on the preponderance of poultry farms. At the second stage, 120 poultry farmers and 20 key informants from the two LGAs were selected through snowball sampling technique.

Instrumentation, measurement of variables and data analysis

Data were collected from the respondents using a well-structured interview schedule, which was translated to Yoruba (the local language of the people). It was used to elicit information on personal and socio-economic characteristics of male and female farmers. The reliability (0.74) of the developed structured interview schedule was validated through test and re-test method. Independent variables such as sex, age, household size, years of experience, flock size, average monthly income from poultry production, types of birds raised, production type, production system and contact with extension agents were studied. Farmers' awareness of poultry waste uses was examined by their responses to Yes or No questions on identified uses which were ranked based on respondents' percentage scores. Responses on utilisation were measured on a 4-point scale of 1 = never used, 2= rarely used, 3 = occasionally used and 4 = regularly used. The total score was obtained by multiplying the scores based on the above 4-point scale by the frequencies and divided by the number of the population studied (120) to arrive at the calculated mean for each variable as the extent of utilization. The grand mean score is the summation of the mean scores of all the variables studied and divided by the total number of variables. The mid-point score (the total values of the 4-point scale divided by 4) was calculated as 2.5 points. Those who scored above it were rated as having high extent of utilization while those under it were rated as having low extent of poultry waste utilization.

The levels of utilisation were calculated based on the absolute values obtained for each variable. A total of 18 uses were identified. The minimum (1) and maximum (4) values ascribed to the 4-point scale was used to multiply the 18 variables to obtain the minimum obtainable score of 18 and the maximum 72 respectively. The least obtainable score (18) was deducted from the maximum (72) to obtain 54 which was

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divided into three to obtain an equal interval of 18. Eighteen was added to the least value (18) to obtain 36 points. Values below 36 points (absolute score) was adjudged low, between 36 and 54 adjudged moderate while higher than 54 was high. Also, farmers' constraints in poultry waste utilisation were examined based on their responses to a 3-point scale of 1 = Not a constraint, 2 = Minor constraint and 3 = major constraint.

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20. The analysis occurred in two phases: First, descriptive statistics (frequency, percentage, mean and standard deviation) were used to summarise the socio-economic variables related to poultry farmers while the variables were ranked based on the mean scores. The test used frequency distributions and mean and standard deviation while the variables were ranked based on the mean scores. Second, inferential statistics such as Chi-square, Pearson Moment Correlation and Analysis of Variance (ANOVA) were used to establish relationships between selected variables and poultry waste utilisation.

RESULTS AND DISCUSSION

Socio-economic characteristics of male and female poultry farmers

The results presented in Table 1 reveal that 56.7% male and 43.3% female engaged in poultry production. The finding corroborated an earlier finding which represents a departure from the dominant role of females in traditional poultry production [15]. The average age (46 ±11.7 years) of the respondents is an indication that most respondents were within the economically active age and capable of taking informed decisions that would enable them benefit significantly in any new activity of poultry production. Similarly, the average household size of 4.8 + 0.09 represents a departure from the traditional practice characterised by large rural household size often used in farm labour [16]. This may imply that poultry farmers would depend more on hired labour.
In addition, the average years of experience of male and female poultry farmers in the study area were 4 years with more male (60.3 %) in the category of 3 to 5 years. This is an indication that majority of the respondents were newcomers in poultry production who may require some practical knowledge in the challenges of poultry waste and its utilisation. Also, the average monthly income of both male and female were low, ranging from ₦11,000 – 20,000 (equivalent to 31 – 56 USD). This finding is similar across regions in developing countries with earnings ranging from 200–250 taka (US$ 2.94) in Bangladesh, GH¢ 1,053 (US$ 175.90) in Brong Ahafo region of Ghana and ₦ 26,623 (US$ 64.96) in Kwara State, Nigeria [17, 18, 19]. These values are considered very low when compared to developed countries [20]. This calls for efficient utilisation of poultry waste which is capable of reducing the cost of production to motivate existing farmers to increase production while new ones particularly the women could be attracted to poultry farming.

Importantly, the results also showed that the average flock size was 100 birds which was reported as rural family poultry, characterised by smallholding [2]. Majority (92.7 % and 71.2 %) of male and female respectively, raised birds for egg production while over 70 % male and female did so for meat production. This implies that poultry production was used to enhance family and national food security as well as for

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improving farmers' livelihoods. Data provided on the production systems revealed that more male than the female farmers used the improved technologies (deep litter and battery cage) characterised by better and more efficient production while almost half of the females still engaged in the traditional method of free-range system characterized with low production and environmental hazard.

Correspondingly, some studies have established that more women than men still engage in free range system of backyard poultry [21, 22]. This is despite more regular contacts with extension agents which points to a gap in technology exposure of female poultry farmers who require attention. Frequent and steady farmers' contacts with extension agents present a unique opportunity for farmers' exposure to available and proven research results in the use of waste to enhance male and female involvement in the poultry enterprise.

Awareness of poultry waste utilisation by male and female respondents

Results in Table 2 reveal a list of eight types of poultry waste with a total of 25 uses. All the male respondents were aware of two (poultry droppings to raise maggot for feeding fish and feathers for aesthetic use) of the identified uses of poultry waste, while the females were aware of five uses (poultry droppings as compost manure for sale, poultry feathers for cultural and aesthetic use, broken eggs for sale and family consumption). The majority, that is 75 % of the male and 98.5 % of the female respondents were aware of 21 and 18 of the poultry uses, respectively. The use of hydrolysed, milled feather meal as feed ingredient recorded the least awareness for both male (7.4 %) and female (51.7 %) followed by manure with respective percentages of 27.9 and 67.4.

This may be due to lack of information or difficulties encountered in the processing of poultry waste, which was affirmed by a female key informant in one of the communities (lyanfoworogi village, Lukosi, Nigeria).

"we know all the poultry waste and hear about the different things they can be used for, some of them actually look impossible to us but would like to know them"

Generally, awareness of poultry waste usage was high but the females had higher awareness than their male counterparts. The differences in awareness may be largely due to gender-based socio-cultural roles in the communities which assigned the responsibility of domestic work to the females, including cleaning of backyard poultry waste.

Extent of poultry waste utilisation by male and female respondents

Table 3 presents data on utilisation of poultry waste by male and female respondents. For the eight poultry waste studied, a total of 18 uses were identified. For the male farmers, poultry litter for making livestock feed ranked highest with a mean score of 1.68 out of a maximum score of 4.0. The second was the use of cracked eggs for family consumption which was closely followed by cake making and their mean scores were 1.58 and 1.50, respectively. The waste with the least ranking (18th) and utilisation scores (0.96) was the use of poultry feathers as manure, while this was close to

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utilization of poultry feathers as feed ingredient that ranked 17th (with score of 1.06), according to the male respondents.

Conversely, the use of cracked eggs for family consumption (with a mean score of 1.66) ranked 1st for the female, while the use of poultry droppings to make biogas and dead birds for making livestock feed (with a mean score of 0.62) ranked least (17th). For both male and female, the scores for all the uses were below the mid-point score of 2.0. This is an indication of a generally low extent of poultry waste utilisation. The poor utilisation of poultry litter, blood and dead birds may be due to the high risk of disease transmission when these wastes are fed to the same avian species.
Several studies in Nigeria, India and Australia, respectively have evaluated the suitability of eggshell and feather meal as dietary source of calcium and protein in the diets of poultry [23, 24, 25, 26]. In spite of available proven research results, technology utilisation was noted to remain low among rural farmers in Nigeria [27].

Level of poultry waste utilisation by male and female respondents
Figure 1 shows that the level of poultry waste utilisation was low as expressed by 93.7 % of male and 96.9 % of female respondents, and none in the high-level utilization category. This finding of a low level of utilisation is revealed despite farmers' awareness of poultry waste usage and contact with extension agents. The traditionally assigned female roles of carrying out domestic activities which include waste management is yet untapped. The low technology adoption and utilisation are due to failure in the process of information transfer [28].

The low level of utilisation by most poultry farmers negates the national policy on research system which emphasises that research generation and delivery should start and end with farmers while extension agents are expected to serve as the link between research and farmers to ensure acceptance and utilisation of research results [29].

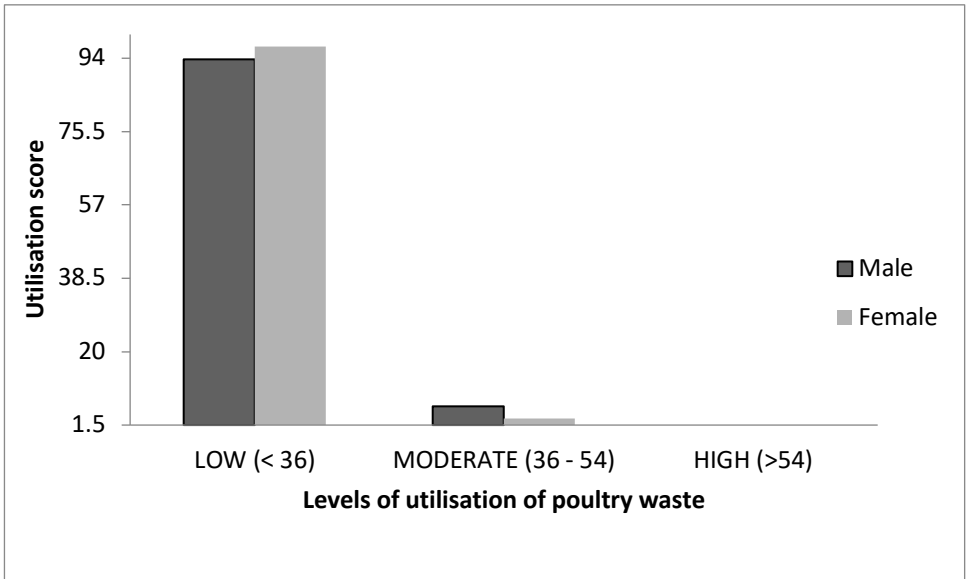

Figure 1: Levels of poultry waste utilisation by males and females

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Constraints to poultry waste utilisation

Results in Table 4 reveal that both the male and female respondents identified all the 11 (eleven) constraints. The male respondents had high mean scores (2.08 to 2.76 out of the expected maximum score of 3.0) in seven of the 11 (eleven) identified constraints. They include four highest scores (in descending order): lack of skill in poultry waste utilisation, odour of poultry droppings, lack of credit facilities and inadequate processing techniques. Similarly, the females had high mean scores (2.17 to 2.83) in eight of the 11 (eleven) identified constraints which they also viewed as major constraints. The four highest scores were complexity of improved techniques, lack of skill in poultry waste utilisation, credit facilities and lack of processing facilities. Generally, constraints related to awareness of the various uses of poultry waste were ranked lowest (0.94 and 0.52) by both male and female farmers, respectively. However, identification of complexity of improved techniques ranked as minor and major constraints by male and female poultry farmers, respectively points to a disparity between male and female in access to and usage of production resources in favour of the male. These findings are in agreement with the reports of the investigation on poultry waste management practices under small-scale intensive urban poultry production in Addis Ababa, Ethiopia that lack of skill in the usage of poultry waste, excessive odour, flies and mosquitoes, financial problems and production-related costs were the major constraints [14].

Therefore, any meaningful effort to address these constraints must focus more on the major ones based on gender considerations to enhance waste utilisation by the males and females. Also, such effort should leverage on high level of farmers' awareness with the possibility of imparting their readiness to acquire knowledge in waste utilisation particularly for the female who are traditionally expected to manage waste generated in homes.

Exploring the potentials in poultry waste utilisation across countries

Globally, the use of poultry waste has generated considerable research interest since the conventional feed materials could no longer meet the needs of the fast-growing livestock species coupled with the need to mitigate the impact of climate variability and waste disposal on the environment. Several studies have established the potentials in poultry waste (Table 5). They include the use of different types of waste to effectively produce a wide range of value-added products such as fertiliser, biodiesel, animal feed, electricity, bone meal and biodegradable plastic [12].

In Virginia, United States, poultry litter has been fed to cattle without any toxic effects. About 20 – 25% of the 5.6 million tons (DM basis) of poultry litter produced annually in the U.S is fed to cattle (beef and stock cows) in Virginia [11]. Similar studies reported that 50% of sampled Bangladesh farmers sold their poultry litter while some used it as fish feed, soil amendment and biogas [14]. Poultry manure has successfully replaced inorganic fertilizer in Pakistan and India for growing forage crops with 65.0 and 19.3% yield increase than the control, respectively [30].

In addition, biogas has been used in Spain to brood chicken at the beginning of the batch. However, in most African countries Nigeria inclusive, biogas production from

poultry manure is unpopular due to factors like the high cost of digester and the huge volume of water required in areas experiencing water scarcity, despite its potential to reduce the domestic burden of women in sourcing for firewood as well as enhancing efficient cooking and forest conservation [31].

Other studies in Africa revealed the enormous potentials in the use of poultry litter and droppings for crop production. In Maradi, Niger, application of poultry manure was found to be cost-effective and substantially increase the yield of pearl millet grain [32]. In Ghana and Uganda, application of poultry manure substantially increased cabbage and maize by 65.55 and 31.53 % yield increase, respectively than the control [33]. In Swaziland, reports exist on the extensive utilisation of solid waste manure on farm fields, sold to make additional money, and given as a gift to neighbouring farmers for land application [31].

However, available evidence revealed a disparity between the global and Nigeria experience. In Nigeria, poultry waste has limited market value but fractionally utilised for fish feeding and sale while manure/compost is used to a lesser extent for crop production. The appropriate nutrients excreted by poultry birds are: nitrogen (N) (65.5%), phosphorus (P) (68.5 %) and 83.5% potassium (K). These elements are essential for soil fertility and increased crop production. Notably, the high phosphorus content in poultry manure was reported to have positive effects on crop growth and production, and surpassed other organic manure in raising the iron (Fe) and manganese (Mn) contents in plants [34].

Thus, preference for poultry manure particularly, is due to its high nutrient content and its utilisation has been found to have implication for creation of new enterprises, preventing pollution and space management. Also, poultry feathers were used as cheap protein sources in livestock feed, technical textiles, biodegradable plastic and organic fertilizer. Notably, researchers have worked on the extraction of calcium from eggshell as dietary calcium source [35, 36]. It was reported to be a cheap source of calcium (Ca) supplement for human and livestock nutrition, with Ca content ranging between 33.13 and 38.0 % capable of solving calcium deficiency, a common problem in rural communities especially in older women [35].

Evidently, studies across countries revealed the enormous untapped potentials of poultry waste. They provide opportunities that could be tapped to address the existing gender gap in poultry farming in order to enhance their livelihood options. Leveraging on the potentials of poultry waste could provide opportunities for the females to develop viable small-scale businesses that can promote gender equity in poultry production as a livelihood option.

Relationships between selected variables and poultry waste utilisation

The results of Chi-square analysis in Table 6 show that sex ($\chi^2 = 49.27$; df = 1; p = 0.004), level of education ($\chi^2 = 5.853$; df = 2; p = 0.017) and primary occupation ($\chi^2 = 121.181$; df = 5; p = 0.01) were statistically related to poultry waste utilisation. Also, the contingency table for Chi Square analysis (Table 7) summarised the extent of poultry waste utilisation by gender. The results revealed that, majority (95.0 %) of the

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respondents had low utilisation while only five percent had moderate utilisation. The results of Pearson Moment Correlation analysis in Table 8 show the relationships between some selected socio-economic variables and utilisation of poultry waste among small-scale poultry farmers in the study area. The findings revealed that years of experience ($r = 0.654$; $p = 0.001$) and flock size ($r = 0.372$; 0.020) had positive significant relationships with poultry waste utilisation while age ($r = -0.365$; 0.025) and average monthly income from poultry production ($r = -0.237$; $p < 0.05$) had negative significant relationships with poultry waste utilisation.

This is an indication that farmers with higher number of years of experience in poultry production would likely utilise waste better. Also, the larger the flock size, the more the waste generated and the better they are able to tap from its potentials. On the contrary, the higher the age of farmers and monthly income, the less they are likely to utilise poultry waste. The results of Analysis of Variance (Table 9) show statistically significant differences ($F = 8.893$; $df = 1$; $p = 0.017$) between male and female levels of poultry waste utilisation. This result affirmed the previous results in Table 3 that the level of utilisation of poultry waste was higher for the male.

CONCLUSION

The study identified the major waste generated along the poultry production chain and assessed the extent of its utilisation by rural poultry farmers for possible wealth creation without compromising gender equity. The findings of the study revealed that gender gap exists in poultry production in Nigeria with the men more involved, having better access to production resources to enhance their livelihood options. Both men and women had similarities of small holding flock size, low income and production. This is an indication that small-scale poultry requires urgent intervention to remain a sustainable venture. Based on community experience of farmers and available proven research results, poultry waste possesses enormous untapped potentials that could be exploited to address gender imbalance in poultry farming. It provides opportunities through which farmers could engage for wealth creation.

Generally, the farmers had high awareness of poultry waste uses, its potentials and enjoyed frequent contact with extension agents which contrarily did not translate to positive impact on utilisation. Instead, there was low extent and level of utilisation of poultry waste by majority of male and female farmers. The constraints to poultry waste utilisation were many but there were similarities in the ranking of identified major constraints. Lack of knowledge about needed technologies, access to credit, odour of waste and skill related challenges topped the list. Many variables including sex were related to utilisation of poultry waste. Therefore, to exploit the untapped potentials of poultry waste to enhance farmers' livelihood options without compromising gender equity, gender should be considered in the design and logistics of training or programme for intervention.

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Table 1: Distribution of respondents' socio-economic and poultry related characteristics

	Gender				
	Male		Female		
Variables	**F**	**%**	**F**	**%**	**Mean±SD**
Sex	68	56.67	52	43.33	
Age (Years)					
≤ 50	51	75.00	39	75.00	
51 - 60	11	16.18	12	23.08	
≥ 61	6	8.82	1	1.92	46±11.74
Household size					
≤ 5	36	52.94	29	55.77	
6 – 10	19	27.94	17	32.69	
≥ 10	13	19.12	6	11.54	4.8±0.09
Years of experience					
0 – 2	27	39.71	29	55.77	
3 – 5	41	60.29	23	44.23	4.0±0.30
Average monthly income from poultry (₦ '000)					
≤ 10	13	19.12	13	25.00	
11 - 20	24	35.29	28	53.85	
21 - 30	14	20.59	9	17.31	
≥ 31	17	25.00	2	3.85	15,070.33±43.0
***Types of birds raised**					
Chicken	68	100.00	52	100.00	
Turkey	26	38.24	12	23.08	
Quail	18	26.47	5	9.62	
Flock size					
≤ 100	40	58.82	24	46.15	
101 – 200	17	25.00	20	38.46	
201 – 300	9	13.24	8	15.38	
>300	2	2.94	0	0.0	100±12.0
***Production type**					
Meat	50	73.53	41	78.85	
Egg	63	92.65	37	71.15	
***Production system**					
Deep litter	68	100.00	52	100.00	
Battery cage	58	85.29	39	75.00	
Free range	5	7.35	25	48.08	
Contact with Ext. agents					
Weekly	17	25.00	13	25.00	
Fortnightly	22	32.35	25	48.08	
Monthly	23	33.82	10	19.23	
Never	6	8.82	4	7.69	

Note: N = 120; *Multiple responses; F = frequency; % = percentage; SD = Standard Deviation

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Table 2: Distribution of respondents based on awareness of poultry waste uses (N = 120)

	Male			Female		
Types of waste generated and uses	**Yes**	**%**	**Ranking**	**Yes**	**%**	**Ranking**
Poultry litter;						
To make livestock feed	52	76.47	22nd	45	96.15	6th
To make bedding material for local chickens	51	75.00	23rd	48	92.31	11th
To make manure	62	91.18	13th	47	90.38	17th
Poultry droppings;						
To make biogas	61	89.71	17th	49	94.23	9th
To raise maggot for feeding fish	68	100.0	1st	42	80.77	23rd
As manure for growing vegetables/crops	67	98.53	3rd	48	92.31	11th
As compost manure for sale	66	97.06	6th	52	100.0	1st
Blood;						
To make poultry by-product meal	65	95.58	9th	47	90.38	17th
Waste water;						
To make manure for planting vegetables	62	91.18	13th	45	86.54	22nd
Dead birds;						
To make livestock feed	63	92.65	12th	48	92.31	11th
Given out as gift to people	61	89.71	17th	45	86.54	21st
Selling it to people	62	91.18	13th	50	96.15	6th
Consumption by farmers	57	83.82	19th	47	90.38	17th
To make manure	53	77.94	21st	49	94.23	9th
Egg shells;						
As feed ingredient	66	97.06	6th	48	92.31	11th
To make egg shell powder for domestic cleaning agent	64	94.18	10th	48	92.31	11th
Poultry feathers;						
As feed ingredients after hydrolysis and milling	5	7.35	25th	27	51.92	25th
To make manure	19	27.94	24th	35	67.31	24th
To make bedding materials for local birds	67	98.53	3rd	48	92.31	11th
For cultural use	62	91.18	13th	52	100.0	1st
For aesthetic use	68	100.0	1st	52	100.0	1st
Cracked eggs;						
For sale	67	98.53	3rd	52	100.0	1st
As gift	55	80.88	20th	50	96.15	6th
For cake making	64	94.18	10th	47	90.38	17th
For family consumption	66	97.06	6th	52	100.0	1st

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Table 3: Gender disaggregated data on the extent of poultry waste utilisation (N= 120)

	Gender					
	Male			Female		
Poultry wastes and uses	**Mean**	**SD**	**Rank**	**Mean**	**SD**	**Rank**
Poultry litter;						
To make livestock feed	1.68	0.52	1st	0.78	0.4	10th
To make manure	1.42	0.65	7th	0.66	0.28	15th
Poultry droppings;						
To make biogas	1.13	0.58	16th	0.62	0.30	17th
To raise maggot	1.24	0.54	15th	0.66	0.26	15th
For growing vegetables/crops	1.45	0.59	5th	0.86	0.34	7th
Blood;						
To make blood meal in feeding livestock	1.31	0.54	10th	0.68	0.28	14th
Waste water;						
To make manure for planting vegetables	1.31	0.52	10th	0.72	0.51	12th
Dead birds;						
To make livestock feed	1.26	0.65	14th	0.62	0.36	17th
To make manure	1.32	0.56	9th	0.71	0.29	13th
Egg shells;						
As feed ingredient	1.47	0.54	4th	0.98	0.27	6th
To make egg shell powder for domestic cleaning agent	1.45	0.56	5th	0.86	0.38	7th
Poultry feathers;						
As feed ingredients after hydrolysis and milling	1.06	0.65	17th	0.83	0.33	9th
To make manure	0.96	0.57	18th	0.74	0.29	11th
To make bedding materials for local birds	1.31	0.63	10th	1.10	0.42	5th
Cracked eggs;						
For sale	1.29	0.63	13th	1.14	0.57	3rd
As gift	1.34	0.57	8th	1.12	0.64	4th
For cake making	1.50	0.57	3rd	1.28	0.56	2nd
For family consumption	1.58	0.54	2nd	1.66	0.51	1st
Grand mean	**1.34**			**0.89**		

Note: SD = Standard Deviation

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Table 4: Constraints encountered in poultry waste utilisation (N = 120)

	Male			Female		
Constraints	**Mean**	**Ranking**	**Decision**	**Mean**	**Ranking**	**Decision**
Lack of skill in poultry waste utilisation	2.76	1st	Major	2.80	2nd	Major
Lack of credit facilities for waste utilisation	2.60	3rd	Major	2.74	3rd	Major
Lack/inadequate processing facilities	2.56	4th	Major	2.65	4th	Major
Poor market for processed waste	2.48	6th	Major	2.31	5th	Major
Poor weather	2.08	7th	Major	2.17	8th	Major
Odour of the poultry droppings	2.72	2nd	Major	2.25	7th	Major
Complexity of improved techniques reduces utilisation of waste	1.98	8th	Minor	2.83	1st	Major
Fear of infectious diseases	1.51	9th	Minor	1.80	9th	Minor
Low level of awareness of waste uses	0.94	11th	Not a constraint	0.52	11th	Not a constraint
Low extension contacts	1.50	10th	Minor	1.66	10th	Minor
High cost of transportation	2.50	5th	Major	2.29	6th	Major

Note: N = 120; Likert-type scale: major constraint = 3, minor constraint = 2, not a constraint = 1

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Table 5: Distribution of poultry waste potential based on research output across countries

Poultry waste	Research output	References
Poultry litter/droppings including dead birds	Fertilizer[a,b,c,d,f,q], bio-diesel[f], animal feed[f,r], electricity[f], bone meal[f], Livestock feed[h], fish feed[a,g,r], biogas for cooking[a,e,k,m,g,q,r] and running turbine[l], litter/ manure are sold[a,e,g], organic fertilizer[b,c,g,q,r], manure as gift for land application[e]	[g][11]; [i][10]; [h][13]; [m][12]; [e][31]; [f][30]; [j][29]; [d][32] [r,b,a][36]; [b][37] [39] [40]
Poultry feathers	Feather meal[f,n], organic fertilizer[f], biodegradable plastic[g]	[o][38]
Egg shell	Calcium in chocolate cakes[o]	[p,q][34]
Cracked eggs	[q]Bakery/cake	

[a,b]Nigeria; [c]Ghana; [d]Uganda; [e]Niger; [f]Swaziland; [g,k,l,o,p]India; [h,q]Bangladesh; [i]United States, [j,m]Pakistan; [n]Spain; [r]Australia

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Table 6: Chi-square analysis showing association between selected variables and poultry waste utilisation in Osun State

Socio-economic variable	χ^2 value	df	p-value
Sex	49.270	1	0.004
Religion	3.685	2	0.522
Level of education	5.853	2	0.017
Primary education	121.181	5	0.001

Note: N = 120; df = degree of freedom; χ^2 = Chi-square

Table 7: Contingency table for Chi Square Analysis showing extent of poultry waste utilisation by gender

	Gender		
Extent of utilisation	Male	Female	Total
Low	64 (93.72 %)	50 (96.88 %)	114 (95.0 %)
Moderate	4 (6.28 %)	2 (3.12 %)	6 (5.0 %)
Total	68 (56.67 %)	52 (43.33 %)	120 (100.0 %)

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Table 8: Correlation analysis showing the relationships between selected variables and poultry waste utilisation

Variables	Correlation coefficient (r)	p-value
Age	-0.365*	0.025
Years of experience	0.654**	0.001
Income from poultry production	-0.237*	0.046
Household size	0.171	0.136
Flock size	0.372*	0.020

Note: N = 120; ****significant at p<0.01; *significant at p<0.05**

Table 9: Analysis of Variance between male and female level of poultry waste utilisation

	Sum of Squares	df	Mean Square	F	p-value
Between groups	206.31	1	206.31	8.893	0.017
Within groups	2737.90	118	23.20		
Total	2944.21	119			

Note: N = 120; df = degree of freedom

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