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ARTICLE

Awareness, Attitude and Behavioural Intention of Medium and Large Scale Poultry Producers to Poultry Waste Management Practices in Lagos State: A Principal Component Analysis

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ABSTRACT

The study analyzed awareness, attitude and behavioural intentions of medium and large scale poultry producers to poultry waste management practices in Lagos State with reference to problems of poor on-farm harness of excessive poultry waste, retrogression/unmet global environmental and economic waste management standards, exorbitant waste management charges imposed by LAWMA. Purposive and simple random sampling (using the lottery draw approach) was used in the selection of sixty (60) medium scale poultry farmers and forty (40) large scale poultry farmers, making a grand total of one hundred (100) medium and large scale poultry farmers interviewed in the study. A semi-structured questionnaire was used to collect data from the selected medium and large scale poultry farmers with the aid of a list provided by the Poultry Association of Nigeria (PAN), Lagos chapter. Principal Component Analysis (PCA) was used to analyse the data. In the principal component analysis for medium scale poultry farmers, the key component named was that LAWMA should offer special service for isolated dead bird collection (V75); and for large scale poultry farmers, the key component was that the disposal of poultry waste in an environmentally friendly way is LAWMA's duty (V76). The study recommended that the government makes provisions to offer awareness campaigns in order to improve environmental knowledge and encourage environmental enthusiasm amongst society.

1. Introduction

Waste is described as a discarded material resulting from agricultural, commercial, communal and industrial activities and it includes solids, liquids and gases (Das, 2021). Waste management involves distinct operations: storage, collection, transfer and transportation, resource recovery, recycling and final disposal [1]. Waste management (WM) has become a public good to which government agency is typically responsible [2]. Effective waste management aims at ensuring that waste does not constitute danger to health and safety of man and the environment at every stage of its handling [3].

Due to increasing volume and attendant complexity of waste generation resulting from the rapid population growth in Lagos State, managing the volume of refuse

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generated on a daily basis has posed a major challenge to the State government, hence the need to establish an outfit for proper waste management in the State [4]. Consequently, the Lagos State Refuse Disposal Board (LSRDB) was instituted under Edict No. 9 of 1977 and was saddled with the responsibilities of environmental sanitation and domestic refuse collection and disposal in the State [5]. Between 2007 and now, various programmes and projects have been introduced, such as Lagos State Waste Management Authority (LAWMA), for improved service delivery across Lagos Metropolis in line with global best practices, while conserving the environment for future generations [6]. Lagos state is now on the verge of turning waste into income generating products, especially with the full collaboration of various stakeholders like commercial farms that generates a huge amount of the needed organic waste for the successful implementation of the project. Consequently, domestic, industrial and organic farm waste, is to become a huge revenue earner for the state and target beneficiaries [7].

In Nigeria, there is a rapid expansion of medium and large scale poultry production with the attendant effect of huge organic waste generation. According to [8] and [9], poultry production is one of the major sub-sectors in Nigerian agricultural industry and produces bulk of these organic waste from livestock enterprises especially from commercialized poultry farms. Medium scale poultry enterprises are poultry farms having between 1001 and 5000 birds while large scale poultry enterprises are poultry farms having between 5001 and less than 10,000 birds [10]. [11] reported that under-developed infrastructure, lack of regulations and poor enforcement, barriers to moving waste from one country to another, and limited recycling opportunities due to economies of scale have stalled progress on sustainable waste management. Hence, there is the need for extensive knowledge and capacity building on the part of governments, professionals and the operators so that the benefits would be realizable. The inability of succeeding governments at various levels of Nigeria to effectively manage Municipal wastes (MW) has become a cause of concern. This may be curbed if awareness, attitude and behavioural intentions of medium and large scale poultry farmers to poultry waste management practices in Lagos State is known. The study becomes imperative.

Objectives of the Study

The aim of this study was to analyze awareness, attitude and behavioural intentions of medium and large scale poultry producers to poultry waste management practices in Lagos State.

2. Method

Study Area

The study was conducted in Lagos State. Lagos State is located in Southwest Nigeria on the west coast of Africa, within latitude $6^0 23'$ N and $6^0 41'$ N, and longitude $2^0 42'$ E and $3^0 42'$ E [12]. Lagos state has an estimated population of 9,113,605 with 4,719,125 males and 4,394,480 females [13]. The population of Lagos is currently estimated to be 21,883,047 million. Lagos economy is highly dependent on service revenue but urban agriculture is relatively minimal. The study area has tropical climate with distinct dry and wet seasons. The dry season is short and occurs between November and March while the wet season starts from April to October [14]. The climatic condition and vegetation pattern favours agricultural practice. Agricultural practices such as market gardening, poultry, snail, bee keeping and livestock farming are common [15]. Availability of farm location has brought relief pressure on some food items such as local and exotic vegetables, eggs, medicinal herbs, maize and chicken to urban household, hotels, food hawkers, foreign owned restaurants scattered all over the state.

Figure 1. Lagos state showing specific LGAs (by dots) in which Medium and Large scale farmers are predominant.

Source: Adapted and modified from Jide (2013)

Sampling procedure

The study population was medium and large scale poultry farmers in Lagos state, Nigeria. A list of registered poultry farmers was compiled with the assistance of staff in the Poultry Association of Nigeria (PAN), Lagos chapter which comprises 256 poultry enterprises (combination of micro-scale, small scale, medium and large scale). From the list, poultry farmers were differentiated according to Local Government Areas (LGAs), out of which ten of the twenty LGAs were

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purposively selected viz: Ikorodu, Epe, Ikeja, Agege, Oshodi-Isolo, Ibeju-Lekki, Ojo, Alimosho, Eti-Osa and Badagry based on available records of the highest number of registered members of the Poultry Association of Nigeria (PAN), Lagos state chapter. Also, poultry farmers from the purposively selected local government areas were also classified according to the type of enterprise/ scale of operation. This was based on the number of birds as medium scale enterprises (between 1001 and 5000 birds) and large scale enterprises (between 5001 and 10,000 birds) [15]. Giving us a total of 72 medium- and 53 large-scale registered poultry enterprises. Employing a simple random sampling, there was a random selection of six (6) medium scale poultry farmers and four (4) large scale (80%) poultry farmers from the selected ten LGAs, giving a total of sixty (60) medium scale poultry farmers and forty (40) large scale poultry farmers, making a grand total of one hundred (100) medium and large scale poultry farmers who were used for the study.

Data collection and Analysis

The study adopted a descriptive survey. A well-structured questionnaire was used to collect data on the waste management practices using a sample of medium and large scale poultry producers. Likert scale rating technique and Principal Component Analysis (PCA) were used to analyze the objective.

Five point Likert scale rating technique

Awareness, attitudes and behavioural intention

Medium and large scale poultry producers' awareness, attitude and behavioral intentions (AAB) relating to sustainable waste management; reduction, reuse, recycle, recover (composting) and safe disposal were obtained. For this purpose, a five point Likert scale method was used to develop 20 attitudinal statements. In the Likert scale, the option "Strongly Agree" was given the highest value of 5 and "Strongly disagree" was given a value of 1. The following scaling procedure was adopted: strongly agree (SA), agree (A), neutral (N), disagree (D), strongly disagree (SD). The values of the five responses were added and further divided by 5 to obtain mean score of 3.00,

$$\frac{5+4+3+2+1}{5}=3.0$$

which was regarded as the mean response level or benchmark to either accept or reject. Based on this, scores below 3.0 (MS<3.0) was taken as a weak factor and was not considered (rejected) while those with mean score of above 3.0 (MS>3.0) was taken as strong factors and considered (accepted).

Factor Analysis

To obtain a quantitative measure of the respondents' responses on awareness, attitude and behavioural (AAB) intentions relating to sustainable waste management, factor analysis was employed. The rule of thumb as was developed by [16] adopted a factor loading of 0.30 and above which was adopted in analysing the data obtained. A varimax rotated factor matrix was then employed to identify the most important factors. Only variables with factor loading of 0.30 and above were used in naming the factors. This implied that variables with coefficient greater than 0.30 were perceived to have high loading and were considered strong factors while those with less than 0.30 were considered minor factors. As was employed by various studies [17]; [18]. The principal component analysis model is stated thus:

$Y1 = a_{11}X_1 + a_{12}X_2 + \ldots + a1nXn$

$Y2 = a_{21}X_1 + a_{22}X_2 + \ldots + a2nXn$

$Y3 = a_{31}X_1 + a_{32}X_2 + \ldots + a3nXn$

. = .

. = .

. = .

$Yn = an_1X_1 + an_2X_2 + \ldots + annXn$

Where; $Y_1, Y_2 \ldots Yn$ = observed variables

$a_1 - an$ = factor loadings or correlation coefficients.

$X_1, X_2 \ldots Xn$ = unobserved underlying factors were used in naming the factors [19].

3. Results and Discussion

Descriptive information

Poultry waste related behavioural intentions are linked with awareness, attitude (including values, beliefs and norms), behavioural control, socio-economic variables and other factors. In that sense, poultry waste in relation to AAB were studied by obtaining the medium and large-scale poultry farmers' weighing for attitudinal statements using the five-point Likert scale method and the Principal Component Analysis (PCA). [20]stated that it is important to study individuals' behaviour, attitudes, and awareness about poultry waste management.

To understand the AAB of respondents regarding SPWM practices, the likert scale rating technique was used but in a bid to identify underlying variable or factors that explains the pattern of correlations within a set of observed variables, PCA was adopted. The average scores are presented in Table 1 and Table 2 for medium- and large-scale poultry producers, respectively.

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Frequency Scores for Attitudinal Statements of Medium Scale Poultry Producers in Lagos state, Nigeria

Table 1. Descriptive likert type information of AAB for sustainable poultry waste management by medium scale poultry producers.

	Sustainable poultry waste management	AWARENESS, ATTITUDE AND BEHAVIOURAL (AAB) INTENTIONS	SA/A	N	D/SD	SD	MEAN	REMARK
1.		I know how to make compost with poultry manure (@1)	29 (48.4)	17 (28.3)	14 (233)	1.346	3.52	ACCEPT
		I am aware that reducing waste is good for the sustainability of the city (@2)	23 (38.3)	13 (21.7)	24 (40.0)	1.578	3.18	ACCEPT
	Awareness/ perception	I am aware of the negative impact of poultry waste burning (@4)	22 (36.7)	9 (15.0)	29 (48.3)	1.783	2.85	REJECT
		I am aware of the negative impact of fly-tipping of poultry waste (V73)	31 (51.7)	10 (16.7)	19 (31.6)	1.544	3.43	ACCEPT
		I am aware that isolated dead birds are not to be disposed of with normal waste (V74)	23 (38.4)	16 (26.7)	21 (35.0)	1.503	3.25	ACCEPT
2.	**Attitudes**	I have no time to make compost with poultry manure (V59)	33 (55.0)	11 (18.3)	16 (26.7)	1.250	3.62	ACCEPT
		I have enough land to make compost with poultry manure (V60)	20 (33.3)	13 (21.7)	27 (45.0)	1.402	2.97	REJECT
		I don't think it's necessary to make compost before selling (V61)	34 (56.6)	11 (18.3)	15 (25.0)	1.427	3.78	ACCEPT
		I would reuse poultry dungs when the time comes (V64)	36 (60.0)	18 (30.0)	6 (10.0)	1.162	3.85	ACCEPT
		If there is not enough incentives for us to reuse and recycle, I wouldn't (V66)	31 (51.7)	16 (26.7)	13 (21.7)	1.451	3.72	ACCEPT
		I like it if someone collects recyclable poultry waste from my poultry farm for a fee (V68)	3 (5.0)	10 (16.7)	47 (78.3)	0.915	1.90	REJECT
		I like to separate poultry waste if there is a regular mobile collection for recyclable materials (V69)	36 (60.0)	8 (13.3)	16 (26.7)	1.432	3.87	ACCEPT
		I would like to take my recyclable waste to drop-in special recycling centers in Lagos state (V70)	26 (43.3)	15 (25.0)	19 (31.6)	1.277	3.38	ACCEPT
		I like it if the recyclable collection facilities are more frequently available in nooks and cranny of the city (V71)	28 (46.7)	12 (20.0)	20 (33.3)	1.523	3.47	ACCEPT
		The LAWMA should offer special service for isolated dead bird collection (V75)	49 (81.7)	8 (13.3)	3 (5.0)	0.985	4.25	ACCEPT
		Disposing of poultry waste in an environmentally friendly way is the responsibility of the LAWMA (V76)	50 (83.3)	5 (8.3)	5 (8.3)	0.963	4.57	ACCEPT
3.		I would like to minimize poultry waste by buying less packaging (V63)	33 (55.0)	12 (20.0)	15 (25.0)	1.339	3.73	ACCEPT
		I am reusing materials to reduce poultry waste (V65)	37 (61.7)	14 (23.3)	9 (15.0)	1.241	3.95	ACCEPT
	Behavioural Intentions	I am recycling poultry farm waste materials which can be recycled (@3)	31 (51.7)	8 (13.3)	21 (35.0)	1.508	3.62	ACCEPT
		We should protect the natural environment from waste for the sake of future generations	19 (31.7)	12 (20.0)	29 (48.3)	1.479	2.98	REJECT

Source: Computed from field survey, 2021.

SA/A = Strongly Agree/Agree; N= Neutral; D/SD= Disagree/Strongly Disagree; SD = Standard deviation;

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PCA of the AAB for sustainable poultry waste management by Medium scale poultry enterprises

Table 2. Total Variance Explained of the Awareness, Attitude and Behavioural intentions (AAB) for sustainable poultry waste management by Medium scale poultry enterprises in Lagos State, Nigeria.

Components	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.771	13.857	13.857	2.771	13.857	13.857	2.017	10.085	10.085
2	2.571	12.855	26.712	2.571	12.855	26.712	1.962	9.810	19.895
3	2.020	10.099	36.812	2.020	10.099	36.812	1.871	9.353	29.249
4	1.721	8.604	45.416	1.721	8.604	45.416	1.799	8.997	38.245
5	1.518	7.592	53.009	1.518	7.592	53.009	1.738	8.688	46.933
6	1.467	7.333	60.342	1.467	7.333	60.342	1.644	8.220	55.153
7	1.074	5.370	65.712	1.074	5.370	65.712	1.594	7.972	63.125
8	1.031	5.156	70.868	1.031	5.156	70.868	1.549	7.743	70.868
9	0.981	4.907	75.775						
10	0.844	4.222	79.998						
11	0.758	3.791	83.788						
12	0.603	3.013	86.802						
13	0.521	2.604	89.406						
14	0.509	2.546	91.952						
15	0.393	1.967	93.920						
16	0.323	1.616	95.535						
17	0.273	1.364	96.899						
18	0.252	1.262	98.161						
19	0.233	1.164	99.325						
20	0.135	0.675	100.000						

Extraction Method: Principal Component Analysis (PCA).

Source: PCA result, 2021

Table 3. Component matrix of the AAB for medium-scale poultry producers

	Component							
	1	2	3	4	5	6	7	8
V75	0.614	-0.007	0.178	-0.212	-0.152	0.512	0.030	-0.280
V65	0.573	-0.049	-0.233	0.444	0.031	0.051	0.383	-0.256
V59	0.565	0.328	-0.153	-0.197	0.132	0.238	-0.145	-0.386
@1	0.548	0.109	0.145	-0.326	0.175	-0.151	-0.127	0.090
V77	0.533	-0.146	0.295	0.395	0.051	0.050	-0.390	0.130
@4	0.459	0.183	-0.123	-0.017	0.385	-0.358	0.215	0.137
V69	0.022	0.654	0.228	0.150	0.229	-0.433	0.018	-0.113
@2	0.290	0.641	0.157	-0.070	-0.215	-0.188	-0.337	0.023
V64	0.458	-0.603	0.223	-0.148	0.348	-0.032	0.160	0.030
V68	-0.308	0.570	0.178	0.001	-0.069	0.298	0.357	0.135
V76	0.040	-0.373	0.703	-0.121	0.114	-0.108	0.395	-0.030
V60	0.366	0.152	-0.561	0.125	-0.170	0.186	0.061	0.084
V74	0.130	0.358	0.381	0.336	-0.147	-0.310	0.079	-0.285
V66	0.200	0.186	0.158	-0.687	-0.147	-0.002	0.224	0.126
@3	0.243	-0.057	0.310	0.638	0.103	0.196	-0.010	0.407
V73	0.047	0.346	0.288	0.168	-0.549	0.092	0.309	0.032
V63	-0.181	0.258	-0.448	0.091	0.478	-0.187	0.226	-0.146
V61	-0.177	0.467	0.349	-0.186	0.478	0.276	-0.161	0.191
V70	-0.257	0.270	0.070	0.164	0.462	0.615	0.051	-0.104
V71	0.424	0.247	-0.379	-0.086	-0.058	0.026	0.183	0.567
Extraction Method: Principal Component Analysis.								
a. 8 components extracted.								

Source: PCA result, 2021

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Table 4. Rotated Component Matrix for medium scale poultry producers' AAB

	Component							
	1	2	3	4	5	6	7	8
V75	0.842	-0.167	0.124	0.019	0.129	0.009	0.189	0.109
V59	0.756	0.183	-0.215	0.118	-0.064	0.116	-0.151	0.167
@1	0.425	0.218	0.172	-0.097	0.086	0.411	-0.212	-0.171
V69	-0.082	0.833	-0.020	0.198	-0.048	0.111	0.025	0.001
V74	0.039	0.661	0.099	-0.090	0.139	-0.176	0.281	0.151
@2	0.307	0.585	-0.313	-0.068	0.102	0.181	0.186	-0.321
V76	-0.013	0.017	0.895	-0.026	0.066	-0.082	0.126	-0.033
V64	0.225	-0.244	0.647	-0.152	0.211	0.185	-0.372	0.159
V60	0.202	-0.169	-0.492	-0.099	0.039	0.331	0.078	0.351
V70	0.064	-0.089	-0.070	0.839	0.051	-0.197	0.000	0.119
V61	0.073	0.208	0.064	0.731	0.045	0.104	-0.054	-0.411
@3	-0.152	0.003	0.101	0.182	0.806	0.112	0.158	0.162
V77	0.246	0.117	0.048	-0.131	0.781	0.012	-0.139	0.004
V71	0.050	-0.115	-0.267	-0.038	0.079	0.796	0.133	0.076
@4	0.052	0.338	0.125	-0.011	0.008	0.574	-0.263	0.263
V66	0.350	-0.012	0.248	-0.049	-0.383	0.404	0.230	-0.331
V73	0.056	0.187	-0.001	-0.061	0.063	-0.004	0.770	0.042
V68	-0.103	0.127	-0.054	0.535	-0.183	0.081	0.575	-0.061
V65	0.248	0.061	-0.002	-0.122	0.203	0.139	0.048	0.809
V63	-0.256	0.211	-0.191	0.303	-0.362	0.145	-0.321	0.388

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 17 iterations.

Source: PCA result, 2021

Table 5. Expressed Rotated Component Matrix for medium scale poultry producers' AAB

Parameters	Component							
	1	2	3	4	5	6	7	8
The LAWMA should offer special service for isolated dead bird collection (V75)	**0.842**							
I have no time to make compost with poultry manure (V59)	**0.756**							
I know how to make compost with poultry manure (@1)	**0.425**							
I like to separate poultry waste if there is a regular mobile collection (V69)		**0.833**						
I am aware that isolated dead birds are not to be disposed with normal waste (V74)		**0.661**						
I am aware that reducing waste is good for the sustainability of the city (@2)		**0.585**						
Disposing of poultry waste in an environmentally friendly way is LAWMA'S duty (V76)			**0.895**					
I would reuse poultry dungs when the time comes (V64)			**0.647**					
I have enough land to make compost with poultry manure (V60)			**0.492**					
I would like to take my recyclable waste to drop-in special recycling centers in the state (V70)				0.839				
I don't think it's necessary to make compost before selling (V61)				0.731				
I am recycling poultry farm waste materials which can be recycled (@3)					0.806			
We should protect the natural environment from waste for the sake of future generations (V77)					0.781			
I like it if the recyclable collection facilities are more frequently available (V71)						0.796		
I am aware of the negative impact of poultry waste burning (@4)						0.574		
If there is not enough incentives for us to reuse and recycle, I wouldn't (V66)						0.404		
I am aware of the negative impact of the fly-tipping of poultry waste (V73)							0.770	
I like it if someone collects recyclable poultry waste from my poultry farm for a fee (V68)							0.575	
I am reusing materials to reduce poultry waste (V65)								0.809
I would like to minimize poultry waste by buying less packaging (V63)								

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 17 iterations. Three components selected

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Table 6. Component Transformation Matrix for medium scale poultry producers' AAB

Components	1	2	3	4	5	6	7	8
1	0.667	0.123	0.081	-0.290	0.376	0.471	-0.083	0.281
2	0.132	0.635	-0.431	0.425	-0.170	0.240	0.340	-0.105
3	0.103	0.312	0.682	0.141	0.338	-0.249	0.294	-0.379
4	-0.375	0.193	-0.210	0.052	0.640	-0.260	0.120	0.533
5	-0.075	0.129	0.259	0.608	0.028	0.167	-0.701	0.149
6	0.411	-0.594	-0.150	0.571	0.177	-0.167	0.262	0.036
7	-0.172	-0.087	0.455	0.114	-0.370	0.294	0.446	0.566
8	-0.427	-0.265	-0.032	0.065	0.370	0.670	0.136	-0.372

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Source: PCA result, 2021

Table 7. KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.761
Bartlett's Test of Sphericity	Approx. Chi-Square	328.781
	Degree of freedom	190
	Significance level	0.000

Source: PCA result, 2021

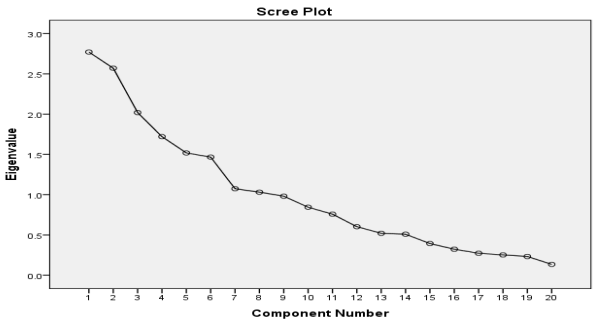

Figure 2. Scree plot of PCA for medium scale poultry producers AAB for sustainable poultry waste management in Lagos state, Nigeria.

Source: computed from field survey, 2021.

Principal Component analysis (PCA)

As presented in Table 2 to Table 6, Principal Component Analysis was used as a data reduction technique in order to group 20 statements into meaningful components and/or to select the most suitable components. In order to use these statements in the PCA, four conditions were fulfilled as suggested by [21]: (1) the sample size exceeded the minimum number of cases by having 300 cases; the number of cases were also more than three times greater than the number of statements; (2) correlation matrix with some coefficients being greater than 0.4; (3) the linearity of the relationships were assumed among variables, and (4) outliers were checked and removed. Kaiser's criterion, Scree test, and total variance were used to determine the number of components.

In Table 2, for the percentage variance under the rotated sums of squared loadings, it was evident that only 8 components met the cut-off point criterion. The percentage variance column tells us how much of the total variability can be accounted for by each of the summary components. For instance, factor one, two and three accounted for 10.085%, 9.810% and 9.353% respectively of the variability in all 20 variables. In Table 3, the component matrix was presented. It shows the initial solution before rotation, without showing the factor loading for each variable. Each number represented the correlation between the item and the unrotated factor (e.g. the correlation between V75 and factor one is 0.614). It is possible to see items with large loadings on several of the unrotated solution which made interpretation difficult. In this case, it was needful to examine a rotated solution which lead us to Table 4. It was pertinent to decide whether an orthogonal solution (employed if factors were not highly correlated) or oblique solution (specifically, Direct Oblimin if factors were correlated with one another). The varimax rotation was employed in the study because it gave the factor loadings for each individual variable in the data set which is what was used to interpret the meaning of the different factors. The expressed rotated component matrix in Table 5 highlighted the rotated factors that loaded more strongly (greater than or equal to 0.4). In the same table, the first three subsets loaded strongly on factor one, two and three and had Eigen value greater than 2. Table 5 showed the orthogonal solution

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while KMO and Bartlett's test were both measures of sampling adequacy and reveals multicollinearity (factors being highly correlated) problems.

According to the results of the PCA, the KMO measure of sampling adequacy is 0.761 (above 0.6) and Bartlett's test is 0.000 (significant because $p<0.05$). These results proved factorability and, hence, the principal component analysis was appropriate for the data set. There were eight components with eigenvalues greater than 1. These components explained the 70.868% of the total variance. The extracted eight components were presented in Table 5.

Scree plot (figure 1), which was developed using the eigenvalue, was used to find the break of the curve in order to determine the number of components. When checking the scree plot, it was also found that the curve started to level out after 8 components (for Eigen value equal to or greater than 1) but on Table 5, the rotated component matrix (that is, in the varimax with Kaiser Normalization), only subsets for the first three components loaded greatly and strongly with Eigen value greater than two and as such was named. Using Table 5, this test suggested a 3-component solution for the 20 statements and, therefore, a three-component solution was decided as the final solution. As suggested by [21], having a small subset with regard to components 4, 5, 6, 7 and 8 also proved the three component solution.

For the purpose of interpretation of the extracted components, the components were rotated using the Varimax rotation method only. This process helps to understand the pattern of loadings without changing the number of components [21]. Direct Oblimin rotation only assumes the correlations among the components. The loadings below 0.4 were dispensed with. The statements were arranged in the order of component loading in each factor. The three main components which were extracted were labelled by considering the statements belonging to them. The first component was named "Attitudes on poultry waste collection and composting" after the higher loading items such as V75, V59 and @1. The second component was called "Awareness and behavioural intentions related to recycling, sorting, and reduction" and considered items V69, V74 and @2. Some recycling related statements were loaded in this component. Finally, the third component was named "Attitudes related to poultry waste disposal and reuse" by considering items such as V76, V64 and V60. All three components extracted had three items in which the loadings were greater than 0.4. These three components explained the linkage between awareness, attitudes, and behavioural intentions relating to SPWM practices. These linkages provide invaluable insight regarding how these three components can be used to encourage medium scale poultry farmers to undertake sustainable poultry waste management (SPWM) practices.

Component one: Attitudes on poultry waste collection and composting

In this component, medium scale poultry farmers were of the view that the LAWMA offer special service for isolated dead bird collection (V75) being aware of the environmental and health implication of such mundane disposal modalities which contaminates the soil, waste land and pollute the farm environment; medium scale poultry farmers also reported having no time to make compost with poultry manures (V59) denoting nonchalance of medium scale poultry farmers who had little or no concern and possibly may prefer to dispose their waste in whatever way they please. A good number of them also claimed to know how to make compost (@1) possibly in the traditional or modern way but the bone of contention is not just in the know but the need to practice so as to reduce the amount of waste to be disposed of by LAWMA, incurement of LAWMA exorbitant fees, and illegal landfills. [22] also pointed out the importance of farmers' perceptions (on the required time and space) regarding composting and that there is a strong need to improve the awareness on composting, in order to reverse the negative thinking associated with it. This is very important as, according to the waste quantification results in this study, approximately 98.3% of PW in this area were organic waste (faecal matter) (Table 4). Most of the time, organic waste was not separated from the rest. In general, these findings confirm the need to improve the environmental knowledge of society.

Component two: Awareness and behavioural intentions related to recycling, sorting, and reduction

Awareness and behavioural intentions relating to recycling, sorting and reduction were as follows: medium scale poultry farmers would separate poultry waste if there were regular mobile collection for recyclable materials (V69), medium scale poultry farmers were aware that isolated birds were not to be disposed with normal waste (V74) and finally medium scale poultry farmers were aware that waste reduction was good for the sustainability of the city (@2).

According to these statements (V69, V74, @2), medium scale poultry farmers can be encouraged to recycle by LAWMA provision of separate waste collection service being offered for recyclable items,

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drop-in collection centres being provided more frequently in the city and monetary incentives. [23] have further explained the need for these requirements by having five components such as; the better condition of Eco-Points, to have information on recycling, to simplify sorting and deposits, to be given material or moral incentives, and to have support and cooperation from others. This component contained a unique set of statements relating to recycling which did not have any cross-loadings. This finding was also in line with [24] in having a clear set of unique practices for recycling related component. A statement of waste reducing attitude (S2) was also listed under this component.

Some of the previous studies obtained a separate component for waste reduction [24, 25], whilst others combined it with other groups [24]. However, as waste reduction also works alongside recycling, this did not violate the concept. The link between attitudes and behavioural intention relating to recycling, which is explained by this component has a policy implication; by forming environmental attitudes, behavioural intentions can be improved (i.e. making a standard and enforcing it, poultry farmers behaviour automatically in tunes with the laid down standard).

[20] also supported the relationship between recycling related attitudes and behavioural intentions found in the current study. [23] have further grouped recycling related aspects. They obtained three components for recycling related attitudes (environment conservation, the pressure of social and personal norms and indifference). [26]'s study also yielded three components; perception of social pressure to recycle, perception of the ability to recycle and the attitude towards recycling. These showed that even small variations within recycling can be captured.

Component three: Attitudes and behavioural intentions related to poultry waste disposal and reuse

All the attitudes related to poultry waste disposal and reuse were loaded into this component (V76, V64, and V60). The statements which were loaded into this component proved that there is a relationship between attitude, behavioural intentions on waste disposal and reuse. The attitudes relating to disposal of poultry waste in an environmentally friendly manner was the responsibility of the LAWMA (V76), the re-use of poultry waste is at a time best known to the medium scale poultry farmer (V64) and medium scale poultry farmers claim to have enough land to make compost (V60). Again, inclusion of the re-use in this component signified need of awareness programmes and incentives for medium scale poultry farmers to form positive environmental attitudes by either re-using their poultry waste or disposing it properly and thereafter improving their behavioural intentions. Again, these links were not as simple as seen and there can be many hidden factors affecting SPWM practices. Some of them can be sufficient facilities, rules and regulations, economic incentives and many more reasons.

Table 8. Descriptive likert type information of AAB for sustainable poultry waste management by large scale poultry producers

			Parameters					
	Sustainable poultry waste management	**AWARENESS, ATTITUDE AND BEHAVIOURAL INTENTIONS (AAB)**	**SA/A**	**N**	**D/SD**	**S.D.**	**MEAN**	**REMARK**
1.	**Awareness/ perception**	I know how to make compost with poultry manure (@1)	13 (32.5)	14 (10.0)	23 (57.5)	1.516	2.90	REJECT
		I am aware that reducing waste is good for the sustainability of the city (@2)	25 (62.5)	3 (7.5)	12 (30.0)	1.565	3.75	ACCEPT
		I am aware of the negative impact of poultry waste burning (@4)	21 (52.5)	3 (7.5)	16 (40.0)	1.692	3.40	ACCEPT
		I am aware of the negative impact of fly-tipping of poultry waste (V73)	23 (57.5)	1 (2.5)	16 (40.0)	1.723	3.43	ACCEPT
		I am aware that isolated dead birds are not to be disposed of with normal waste (V74)	15 (37.5)	9 (22.5)	16 (40.0)	1.446	3.10	ACCEPT
2.	**Attitudes**	I have no time to make compost with poultry manure (V59)	14 (38.0)	2 (5.0)	24 (60.0)	1.630	2.90	REJECT
		I have enough land to make compost with poultry manure (V60)	23 (57.5)	4 (10.0)	13 (32.5)	1.625	2.78	REJECT
		I don't think it's necessary to make compost before selling (V61)	17 (42.5)	2 (5.0)	21 (52.5)	1.679	3.05	ACCEPT
		I would reuse poultry dungs when the time comes (V64)	25 (62.5)	3 (7.5)	12 (50.0)	1.625	3.78	ACCEPT

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		If there is not enough incentives for us to reuse and recycle, I wouldn't (V66)	24 (60.0)	5 (12.5)	11 (27.5)	1.645	3.75	ACCEPT
		I like it if someone collects recyclable poultry waste from my poultry farm for a fee (V68)	11 (27.5)	23 (57.5)	6 (15.0)	1.616	2.95	REJECT
		I like to separate poultry waste if there is a regular mobile collection for recyclable materials (V69)	17 (42.5)	5 (12.5)	18 (45.0)	1.613	3.25	ACCEPT
		I would like to take my recyclable waste to drop-in special recycling centers in Lagos state (V70)	14 (35.0)	6 (15.0)	20 (50.0)	1.363	2.70	REJECT
		I like it if the recyclable collection facilities are more frequently available in nooks and cranny of the city (V71)	9 (22.5)	13 (32.5)	17 (45.0)	1.203	2.70	REJECT
		The LAWMA should offer special service for isolated dead bird collection (V75)	17 (42.5)	5 (12.5)	18 (45.0)	1.693	3.18	ACCEPT
		Disposing of poultry waste in an environmentally friendly way is the responsibility of the LAWMA (V76)	21 (52.5)	2 (5.0)	17 (45.0)	1.760	3.33	ACCEPT
3.	**Behavioural Intentions**	I would like to minimize poultry waste by buying less packaging (V63)	23 (57.5)	9 (22.5)	8 (20.0)	1.292	3.85	ACCEPT
		I am reusing materials to reduce poultry waste (V65)	23 (57.5)	6 (15.0)	11 (27.5)	1.615	3.58	ACCEPT
		I am recycling poultry farm waste materials which can be recycled (@3)	14 (35.0)	7 (17.5)	19 (47.5)	1.559	3.33	ACCEPT
		We should protect the natural environment from waste for the sake of future generations (V77)	9 (22.5)	2 (5.0)	39 (72.5)	1.509	2.33	REJECT

SA/A = Strongly Agree/Agree; N= Neutral; D/SD= Disagree/Strongly Disagree; S.D. = Standard deviation**;**

Source: Computed from field survey, 2021

PCA of the AAB for sustainable poultry waste management by large scale poultry enterprises

Table 9. Total Variance Explained of the Awareness, Attitude and Behavioural intentions (AAB) for sustainable poultry waste management by large scale poultry enterprises in Lagos State, Nigeria.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.041	15.205	15.205	3.041	15.205	15.205	2.572	12.862	12.862
2	2.499	12.497	27.701	2.499	12.497	27.701	2.319	11.595	24.457
3	2.376	11.878	39.579	2.376	11.878	39.579	2.278	11.391	35.848
4	1.832	9.162	48.741	1.832	9.162	48.741	1.803	9.014	44.861
5	1.512	7.559	56.300	1.512	7.559	56.300	1.792	8.959	53.821
6	1.438	7.190	63.490	1.438	7.190	63.490	1.693	8.465	62.286
7	1.235	6.173	69.663	1.235	6.173	69.663	1.475	7.377	69.663
8	0.989	4.945	74.608						
9	0.800	4.000	78.608						
10	0.770	3.852	82.460						
11	0.675	3.377	85.837						
12	0.591	2.953	88.790						
13	0.486	2.432	91.222						
14	0.387	1.936	93.158						
15	0.363	1.817	94.974						
16	0.275	1.376	96.350						
17	0.268	1.342	97.691						
18	0.232	1.159	98.851						
19	0.146	0.728	99.579						
20	0.084	0.421	100.000						

Extraction Method: Principal Component Analysis.

Source: PCA result, 2021

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Table 10. Component matrix for large scale poultry producers' AAB

	Components						
	1	2	3	4	5	6	7
V68	0.797	-0.096	-0.041	-0.006	-0.030	-0.034	-0.167
V69	0.636	-0.361	-0.164	0.027	0.129	0.041	-0.093
V76	0.629	0.219	0.475	-0.183	-0.065	0.010	0.102
V61	0.599	0.377	-0.354	-0.162	0.074	0.164	0.262
V74	0.598	-0.265	0.111	0.301	-0.090	-0.360	-0.201
V77	-0.476	0.312	0.254	0.288	0.330	-0.341	-0.126
@3	0.443	0.237	0.441	0.201	0.316	-0.172	0.135
V60	0.142	-0.692	0.043	-0.487	-0.017	0.132	0.182
V59	-0.040	0.667	-0.376	0.079	0.086	0.337	0.210
V75	-0.019	0.558	0.106	-0.397	-0.180	0.101	-0.484
@1	0.295	0.515	-0.394	-0.311	0.286	0.020	-0.031
V70	0.207	0.485	-0.300	0.326	-0.217	-0.403	0.218
V64	0.253	0.171	0.636	-0.120	-0.265	-0.271	0.331
V66	-0.072	0.171	0.624	-0.050	0.104	0.533	-0.139
V65	-0.291	-0.165	-0.421	0.114	-0.348	-0.196	0.209
V63	0.202	0.083	-0.033	0.684	-0.185	0.269	-0.050
V73	0.094	-0.147	0.106	0.615	0.274	0.276	-0.244
@2	0.108	-0.286	-0.361	-0.002	0.735	-0.003	0.172
@4	0.285	-0.111	-0.301	0.181	-0.498	0.411	-0.071
V71	-0.138	-0.061	0.347	0.213	0.006	0.341	0.644

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

Source: PCA result, 2021

Table 11. Rotated Component matrix for large scale poultry producers' AAB

	Component						
	1	2	3	4	5	6	7
V76	0.756	0.122	0.223	-0.178	-0.081	0.205	0.025
@3	0.724	0.091	-0.205	0.148	0.160	0.094	0.064
V64	0.685	-0.147	-0.059	-0.364	-0.237	-0.045	0.283
V74	0.518	-0.325	0.230	0.113	0.299	-0.263	-0.331
V68	0.504	0.069	0.494	0.152	0.161	-0.028	-0.350
V59	-0.175	0.812	-0.100	-0.090	0.154	-0.024	0.166
@1	0.090	0.728	0.026	0.142	-0.185	0.010	-0.307
V61	0.289	0.703	0.382	0.126	-0.033	-0.117	-0.023
V77	-0.002	-0.065	-0.835	-0.002	0.103	0.014	-0.033
@4	-0.177	0.088	0.625	-0.245	0.371	-0.106	0.008
V60	-0.039	-0.388	0.554	0.285	-0.452	0.160	0.136
V69	0.272	-0.057	0.522	0.394	0.155	-0.025	-0.244
@2	-0.081	0.139	-0.005	0.875	-0.048	0.007	-0.017
V75	0.008	0.329	-0.099	-0.548	-0.176	0.350	-0.431
V63	0.051	0.061	0.116	-0.116	0.753	-0.100	0.124
V73	0.016	-0.136	-0.068	0.255	0.700	0.226	-0.004
V66	0.147	-0.010	-0.101	-0.244	0.133	0.761	0.228
V70	0.228	0.392	-0.147	-0.174	0.182	-0.662	-0.046
V65	-0.406	-0.098	0.062	-0.076	-0.051	-0.552	0.120
V71	0.093	-0.037	-0.018	0.025	0.094	0.113	0.829

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Rotation converged in 10 iterations.

Source: PCA result, 2021

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Table 12. Expressed Rotated Component matrix for large scale poultry producers' AAB

Parameters	Component						
	1	2	3	4	5	6	7
Disposing of poultry waste in an environmentally friendly way is LAWMA'S duty (V76)	**0.756**						
I am recycling poultry farm waste materials which can be recycled (@3)	**0.724**						
I would reuse poultry dungs when the time comes (V64)	**0.685**						
I am aware that isolated dead birds are not to be disposed with normal waste (V74)	**0.518**						
I like it if someone collects recyclable poultry waste from my poultry farm for a fee (V68)	**0.504**						
I have no time to make compost with poultry manure (V59)		**0.812**					
I know how to make compost with poultry manure (@1)		**0.728**					
I don't think it's necessary to make compost before selling (V61)		**0.703**					
We should protect the natural environment from waste for the sake of future generations (V77)			**-0.835**				
I am aware of the negative impact of poultry waste burning (@4)			**0.625**				
I have enough land to make compost with poultry manure (V60)			**0.554**				
I like to separate poultry waste if there is a regular mobile collection (V69)			**0.522**				
I am aware that reducing waste is good for the sustainability of the city (@2)				0.875			
The LAWMA should offer special service for isolated dead bird collection (V75)				-0.548			
I would like to minimize poultry waste by buying less packaging (V63)					0.753		
I am aware of the negative impact of the fly-tipping of poultry waste (V73)					0.700		
If there is not enough incentives for us to reuse and recycle, I wouldn't (V66)						0.761	
I would like to take my recyclable waste to drop-in special recycling centers in the state (V70)						-0.662	
I am reusing materials to reduce poultry waste (V65)						-0.552	
I like it if the recyclable collection facilities are more frequently available (V71)						.	0.829
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 10 iterations.							

Source: PCA result, 2021

Table 13. Component transformation matrix for large scale poultry producers' AAB

Component	1	2	3	4	5	6	7
1	0.707	0.208	0.582	0.164	0.172	-0.055	-0.242
2	0.192	0.768	-0.425	-0.432	0.047	0.015	-0.065
3	0.565	-0.443	-0.276	-0.291	-0.028	0.498	0.273
4	0.036	-0.131	-0.236	0.076	0.896	-0.291	0.178
5	0.097	0.196	-0.406	0.810	-0.022	0.353	-0.074
6	-0.324	0.281	0.423	-0.058	0.311	0.645	0.348
7	0.170	0.192	0.064	0.188	-0.258	-0.351	0.840

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Source: PCA result, 2021

Table 14. KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.657
Bartlett's Test of Sphericity	Approx. Chi-Square	254.467
	Degree of freedom	190
	Significance level	0.001

Source: PCA result, 2021

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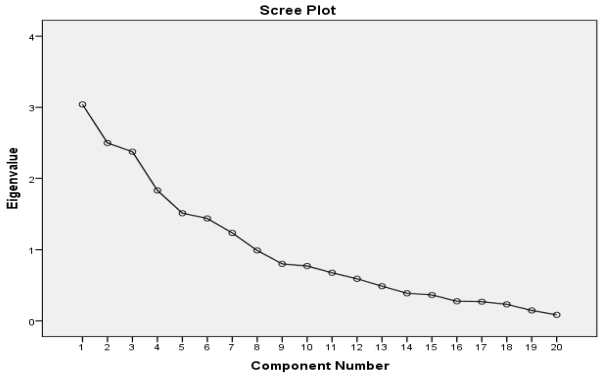

Figure 3. Scree plot of PCA for large scale poultry producers AAB for sustainable poultry waste management in Lagos State, Nigeria.

Source: computed from field survey, 2021

Principal Component analysis (PCA)

As described in Table 9 above, principal component analysis was used as a data reduction technique in order to group 20 statements into meaningful components and/or to select the most suitable components. Kaiser's criterion, Scree test, and total variance were used to determine the number of components. According to the results of the PCA, the KMO measure of sampling adequacy is 0.657 (above 0.6) and Bartlett's test is 0.001 (significant because $p<0.05$). These results prove factorability and, hence, the principal component analysis was appropriate for the data set. There were seven components with eigenvalues greater than 1. These components explained the 69.663% of the total variance. The extracted seven components are presented in Table 12.

In Table 9 labelled the total variance explained, the percentage (%) variance under the rotated sums of squared loadings, it was evident that only 7 components met the cut-off point criterion. The percentage variance column explained how much of the total variability can be accounted for by each of the summary scales or components. For instance, factor one, two and three accounted for 12.862%, 11.595% and 11.391% respectively of the variability in all 20 variables. In table 10, the component matrix was presented. It showed the initial solution before rotation, without showing the factor loading for each variable. Each number represented the correlation between the item and the unrotated factor (e.g. the correlation between V68 and factor one is 0.797). It is possible to see items with large loadings on several of the unrotated solution which made interpretations difficult. In this case, it was needful to also examine a rotated solution which led us to table 11. The varimax rotation was employed in the study because it gave the factor loadings for each individual variable in the data set which is what was used to interpret the meaning of the different factors. The expressed rotated component matrix in table 12 highlighted the rotated factors that loaded more strongly (greater than or equal to 0.4). In the same table, the first five subsets loaded strongly on factor one, three subsets on factor two and four subsets on factor three and had Eigen value greater than 2. Table 13 showed the orthogonal solution while KMO and Bartlett's test were both measures of sampling adequacy.

Scree plot (Figure 2), which was developed using the eigenvalue was used to find the break of the curve in order to determine the number of components. When checking the scree plot, it was also found that the curve started to level out after 7 components (for Eigen value equal to or greater than 1) but on table 12, the rotated component matrix (i.e. in the varimax with Kaiser Normalization), only subsets for the first three components loaded greatly and strongly with Eigen value greater than two and as such would be named. Using table 12, this test suggested a 3-component solution for the 20 statements and, therefore, a three-component solution was decided as the final solution. As suggested by [21], having a small subset with regard to components 4, 5, and 7 also proved the three component solution.

For the purpose of interpretation of the extracted components, the components were rotated using the Varimax rotation method only. The loadings below 0.4 were dispensed with. The statements were arranged in the order of component loading in each factor. The three main components which were extracted were labelled by considering the statements belonging to them. The first component was named "Attitudes on poultry waste disposal, recycling and reuse practices" after the higher loading items such as V76, @3, V64, V74 and V68. The second component was called "Attitude and Awareness related to composting of poultry waste" and considered items V59, @1 and V61. Finally, the third component was named as "Attitudes and Behavioural intentions related to poultry waste management" by considered items such as V77, @4, V60, and V69. All three components extracted had three items in which the loadings were greater than 0.4. These three components explained the linkage between awareness, attitudes, and behavioural intentions relating to SPWM practices. These linkages provided invaluable insight regarding how these three components can be used to encourage large scale poultry farmers to undertake SPWM practices.

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Component one: Attitudes on poultry waste disposal, recycling and reuse practices

All the statements relating to environmental concerns and attitudes apropos the harmful impact of poultry waste were, as expected, loaded into one component. The statement of large scale poultry farmer's attitude regarding poultry waste disposal, recycling and reuse practices in relation to the environment was grouped under the attitude statements (V76, @3, V64, V74 and V68) and are expressed as disposal of poultry waste in an environmentally friendly way is LAWMA's duty (V76), recycling poultry farm waste materials which can be recycled (@3), reusing poultry dungs when the time comes (V64), awareness that isolated dead birds are not to be disposed with normal waste (V74) and collection of recyclable poultry waste for a fee (V68).

From the result, it was hypothesized that the private sector participation (PSP) contractors of the Lagos Waste Management Agency (LAWMA) may not be performing up to expectations, LAWMA possibly may not be monitoring effectively the operations of the PSP and some large scale poultry farmers do not believe themselves as key actors to environmental friendly disposal of poultry waste.

From the result, it was revealed that good number of large scale poultry farmers recycled poultry waste that can be recycled. A low-temperature, catalytic tertiary conversion process for recycling organic materials is proposed for application to poultry litter and other animal waste. Current environmental problems associated with disposal of poultry wastes provide excellent opportunities for use of this recycling technology to minimize the volume of litter, manure, and modalities requiring disposal; sterilize litter material for reuse in multiple rotations; and reclaim valuable nutrient and mineral resources using a safe, closed system.

Component two: Attitude and Awareness related to composting of poultry waste

According to these statements (V59, @1 and V61), large scale poultry farmers can be encouraged to compost. The statements are explicitly expressed as lack of time to make compost with poultry manure (V59), knowledge of making compost with poultry manure (@1), and nonchalance to make compost before selling (V61).

From the result, large scale poultry farmers complained about lack of time to compost possibly because of several other farm engagements and concerns. From the other result, it's a common knowledge that composting organic waste and other biological material is much better than sending them as city dumps, where they would end up not being harnessed into methane gas. Time factor consideration was of two dimensions (1) time to make compost pile and (2) time it takes the compost to mature and a good knowledge on composting modalities can provide a long lasting solution to some waste management/environmental concerns and increases the value of compost sold to crop farmers by some of these large scale poultry farmers.

Component three: Attitudes and Behavioural intentions related to poultry waste management

All the attitudes and behavioural intentions related to poultry waste general management were loaded into this component (V77, @4, V60 and V69). The statements which were loaded into this component proved that there is a relationship between attitude and behavioural intentions on poultry waste management. The attitudes cum behavioural intentions were expressed as: protection of the natural environment from waste for the sake of future generations (V77), awareness of the negative impact of poultry waste burning (@4), having enough land to make compost with poultry manure (V60) and separation of poultry waste if there is a regular mobile collection (V69).

The capacity of the natural environment to absorb and process these poultry waste materials is also under stress. Valuable resources in the form of matter and energy are lost during waste disposal and burning, requiring that a greater burden be placed on ecosystems to remedy the situation. Most contemporary poultry waste management efforts were focused at local government level and some were based on high tech / high energy waste disposal methods such as sanitary landfill and incineration (bio-burning) which better protects the natural environment. However, these methods are becoming increasingly expensive and energy inefficient. The financial costs of managing the long-term environmental impacts of waste disposal are many times what is actually charged for this regular LAWMA services and in many cases corrective action is not remotely feasible. The purely environmental costs such as negative effects on habitat, wildlife and biodiversity are also recognized. In other words, waste management is not sustainable and will have negative implications for future generations.

4. Conclusions and Recommendations

Awareness and knowledge play a major role in the SPWM practices of poultry farmers in developing

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countries. The resultant links between the awareness, attitudes and behavioural intentions regarding recycling and composting revealed the importance of awareness in engaging in SPWM practices. Based on the findings of this study, the following recommendations were made:

1) It is important to offer awareness campaigns in order to improve environmental knowledge and encourage environmental enthusiasm amongst society.

2) Although, general waste education is contained in the school curriculum, it is important to include more detailed information regarding organic waste management.

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