

MULTIVARIATE ANALYSES OF DETERMINANTS OF EXOTIC DUCK ADOPTION IN SOUTH-WEST NIGERIA: IMPLICATION ON INDIGENOUS DUCK GENETIC RESOURCES

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Abstract. Poultry products contribute substantial proportion of animal protein consumed in Nigeria. These products are derived from both indigenous and exotic breeds of available species. The present study investigated the determinants of adoption of exotic ducks in south-west Nigeria through the application of classification regression tree (CRT) and binary logistic regression (BLR) model. Besides, the implication of adoption of improved breeds of duck on indigenous duck genetic resources was also considered. Multi-stage, stratified and cluster sampling methods were used to collect primary data from 524 respondents through structured questionnaires in three south-west states of Nigeria. About half (51.50%) of respondents indicated interest to adopt exotic ducks. In addition, the results of CRT (risk value = 33.6) and BLR ($X^2=0.727$, $P=0.197$) were in consonance and both multivariate statistical techniques identified consumption of duck products followed by duck keeping as the principal determinants of exotic duck adopters among the respondents. The two principal indicators of potential exotic duck adopters could aid in guiding animal breeders, extension agents and stakeholders involved in animal agriculture in identifying potential adopter of exotic ducks in south-west Nigeria. Considering the expressed interest of the respondents to adopt improved breeds of ducks, this suggests the need for concerted effort of animal breeders and other stakeholders involved in livestock production to guard against possible 'genetic erosion' of the valuable germplasm inherent in indigenous ducks via neglect through conservation.

Keywords: Animal agriculture, extension agents, genetic erosion, logistic regression, valuable, germplasm.

INTRODUCTION

Waterfowl production has progressed rapidly in the past few decades and will, without doubt, continue to play an increasingly important role in the world with respect to food production and security (Huang *et al.*, 2012). Among domesticated avian species in Nigeria, duck a member of class of poultry known as waterfowl was ranked third with an estimated population of 9 553 911 after chicken (101 676 710) and guinea fowl (16 976 907) (NBS, 2012). Ducks are found in all agro-ecological zones of

Nigeria (Oguntunji and Ayorinde, 2015a). They have been domesticated in this country since time immemorial and contribute significantly to the socio-cultural, menu and also serve as 'living bank', most especially to rural keepers. Among *genera* of duck, Muscovy duck (*Cairina moschata*) popularly known as local duck and common duck (*Anas platyrhynchos*) known as exotic duck, are the most common ones reared in Nigeria (Oguntunji and Ayorinde, 2014a). Of these two *genera*, Muscovy duck is more numerous with significant presence all over the country (Nwanta *et al.*, 2006; Adeyemi *et al.*, 2008; Oguntunji and Ayorinde 2015b).

In spite of the preponderance of Muscovy duck (*Cairina moschata*) in Nigeria, its age-long adaptation to the prevailing hot tropical environment compared to exotic breed (Oguntunji and Oluwatomi, 2016), its presence in all agro-ecological zones (Oguntunji and Ayorinde, 2015a) and innate potential for meat and egg production (Oguntunji and Ayorinde, 2014b, Yakubu, 2012); this waterfowl is one of the least exploited and underutilized indigenous poultry species in Nigeria. The neglect suffered by this bird might not be unconnected with the throng of taboos, superstitions, bias and social stigmas attached to its rearing, consumption, handling and marketing (Oguntunji, 2014; Oguntunji and Ayorinde, 2014b).

Introduction of exotic breeds of ducks could go a long way in circumventing the aforementioned taboos and stigmas and other allied shortcomings associated with Muscovy ducks such as low egg production (Ogah *et al.*, 2011; Oguntunji *et al.*, 2015) and seasonal effect on egg production (Oguntunji *et al.*, 2015). Besides, introduction of exotic duck breeds could provide alternative platform for accelerated duck production; thereby increasing production and demand for duck products, most especially among the elites and urban dwellers that are less inclined to the taboos than rural dwellers.

Documentary evidence on how and when exotic ducks were introduced to Nigeria is not available. However, there is likelihood that they were introduced to the country by the early European traders and colonists. At present there is no empirical report on the prevalent breed of exotic duck in southwest Nigeria, nevertheless, Mallard, Khaki Campbell and Pekin ducks were the most common breeds among duck farmers.

Though exotic ducks are found in Nigeria, their husbandry and utilization for nutritional and economic purposes are limited compared to the local Muscovy ducks. It is worth emphasizing that efficient utilization of non-conventional animal genetic resources among which is duck in addition to the conventional ones is critical to filling the gap created by inadequate supply of animal products. Besides, commercial production of such animals could be of economic benefit as alternative source of income to farmers and also create employment opportunities.

A recent report by Oguntunji and Ayorinde (2015b) revealed that unavailability, ignorance of existence, fear of suitability to extensive management system and acceptability among the populace among others were the principal reasons advanced for non-adoption of exotic ducks by duck farmers in Nigeria. Investigating determinants of exotic chicken adoption in Nigeria, Lawal *et al.* (2007) reported that house-hold heads with longer years of experience in rearing exotic chickens, larger flock size, use of purchased inputs (drugs and vaccines), more income from the sale of chickens and contact with extension agents are the major factors influencing adoption of exotic chickens by Lake Kainji fisherfolks in North-central, Nigeria. Conversely, a

related study conducted in Amhara region of Ethiopia reported sex of respondents, distance from road, distance from town, management system, number of poultry sold per year in the market, access to training and year of adoption as the factors significantly influencing intensity of adoption of exotic chickens (Tamir *et al.*, 2016).

Scientific studies on determinants of adoption of exotic duck breeds in Nigeria, as well as other tropical region are lacking but are central to successful introduction, multiplication and utilization of this waterfowl. The findings of such studies would go a long way in guiding animal breeders, extension agents and stakeholders involved in animal agriculture in identifying potential adopters of exotic ducks. It would also contribute significantly in formulating policies on production, distribution of exotic breeds of duck, monitoring and provision of technical assistance for the would-be adopters of exotic breeds of duck.

In view of the foregoing, the present study was conducted to investigate determinants of adoption of exotic ducks in south-west Nigeria using classification regression tree and binary logistic regression. Besides, the study considers implication of exotic duck adoption on the indigenous duck genetic resources.

MATERIAL AND METHODS

Study Area. The study was carried out in Oyo, Osun and Lagos States in south-west Nigeria (Figure 1) between August 2016 and April 2017.

The approximate coordinates of the three states are 7°30'N 4°30'E, 8°00'N 4°00'E and 6°35'N 3°45'E for Osun, Oyo and Lagos, respectively.

The states were predominantly occupied by *Yoruba* ethnic group, one of the three major ethnic groups in Nigeria. The zone is richly endowed with fertile land for cultivation of both arable and cash crops.

A multi-stage sampling technique was adopted for the study using purposive and random sampling techniques. In the first stage, three states namely Lagos, Oyo and Osun were selected based on duck availability and production. In the second stage, one senatorial district was selected from each state (Oyo state: Oyo Central, Osun state: Osun West and Lagos state: Lagos East) and then five local government areas (LGAs) were purposively selected from each senatorial district:

Oyo State: Oyo West, Oyo East, Atiba, Afijio and Akinyele

Osun State: Iwo, Ayedire, Ede, Ejigbo and Ayedaade

Lagos State: Epe, Eredo, Ikorodu, Eti-Osa and Kosofe

Then 30 questionnaires were randomly distributed by the trained enumerators in each of the selected LGAs to both duck farmers and non-duck farmers since the aim was to identify determinants of adoption of exotic ducks in the study area.

The hypothesized independent variables of adoption of improved duck breeds are state, sex, age, occupation, marital status, religion, educational qualification, access to social media, awareness on exotic duck, duck keeping and consumption of duck products.

Statistical analyses. Data were analysed with descriptive statistics (percentage) and two multivariate statistical techniques: binary logistic regression (BLR) model and classification regression tree (CRT).

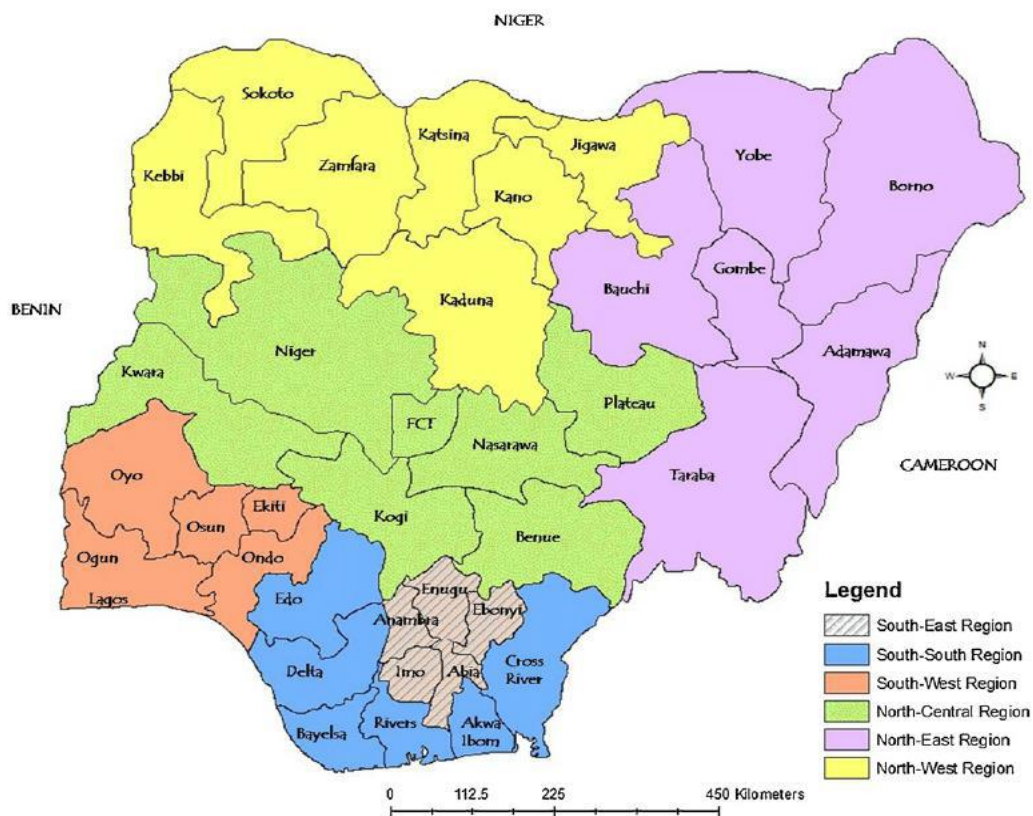


Fig. 1. Map of Nigeria showing the study area
 Source: Google image, 2018.

Univariate analysis. Univariate analysis of the hypothesised predicting variables and possibility of adopting exotic duck was carried out using Pearson’s Chi-square (X^2) test.

Logit regression model. The logit regression model is a unit or multivariate technique which allows for estimating the probability that an event occurs or not by predicting a binary dependent outcome from a set of independent variables (Akintunde, 2015). This model allows the prediction of group membership from a set of categorical and/or continuous variables (x) (Yakubu *et al.*, 2014). The dependent variable in this model is the adoption of exotic duck and was dichotomised with a value of 1. A respondent was recorded as 1 if ready to adopt (adopter) exotic breeds of duck and 0 (non-adopter) if otherwise.

Subsequently, a multivariate model was built by including every hypothesized determinant having P-value of 0.10 from univariate analysis (Czopowicz *et al.*, 2012). Variables were considered important in predicting would-be adopters if its P-value was less than 5% ($P < 0.05$) in the final logistic regression model. The Chi-square goodness-of-fit test was performed to check if the multivariate model fit the data well ($P < 0.05$) (Hosmer and Lemeshow 2000). The logistic multivariate model employed was according to Czopowicz *et al.* (2012):

$$P(Y=1) = \frac{1}{1 + \exp [-(B_0 + B_1 \times X_1 + \dots + B_n \times X_n)]}$$

where,

$P(Y=1)$ = probability of an event occurring (adoption).

B_0 = intercept

B_1, B_n = regression coefficients for predicting variables

X_1, X_n = Predicting variables (state, sex, age, occupation, marital status, religion, educational qualification, access to social media, awareness on exotic duck, duck keeping and consumption of duck products).

Classification regression tree. Classification regression tree is a non-parametric statistical procedure that identifies mutually exclusive and exhaustive sub-groups of a population whose members share common characteristics that influenced dependent variable of interest (Lemon *et al.*, 2003). The CRT is a popular data mining alternative to the probit, linear and logit models of analysing categorical traits (Piwczynski, 2009). It allows one to create graphical model that resembles tree-like structures, with a root, trunk, branches and leaves {Lasek, 2007 (as cited in Ghiasi *et al.*, 2015); SAS, 2013}. This prediction model accommodates both numeric and categorical dependent variables conveniently and the nature of the target/dependent variable determines the name and the steps involved in the analysis without affecting the final result (Oguntunji, 2017). When the dependent or target variable is categorical, the model is called classification tree while the model is referred to as regression tree when dependent variable is continuous (Lemon *et al.*, 2003).

Since the target variable (adoption of exotic duck) is a categorical variable, Chi-square Automatic Interaction Detector (CHAID) was used to analyse the data. The statistical analysis of CRT was according to the method described by Yakubu *et al.* (2014). Besides, multicollinearity test was carried out on all the hypothesized variables through Variance inflation factor before data analysis. Then, data were analysed with SPSS version 16 (2001).

RESULTS AND DISCUSSIONS

Univariate analysis of the predicting factors revealed that 9 of the 11 hypothesised independent variables significantly ($P < 0.05$) influenced probability of adoption of exotic ducks except ($P > 0.05$) educational qualification and religion (Table 1).

Logistic regression

The bivariate logistic regression model revealed that consumption of duck products ($P = 0.000$; Odds ratio = 3.178; Wald = 27.928), duck keeping ($P = 0.000$; Odds ratio = 4.284; Wald = 12.344), state of residence of respondents ($P = 0.001$; odd ratio (OR) = 1.536; Wald = 10.456) and awareness on exotic duck ($P = 0.014$; Odds ratio = 1.694; Wald 6.072) significantly ($P < 0.05$) influenced the probability of adoption of exotic duck in the study area (Table 2). However, their Wald values indicating the relative contribution of the independent variables to the probability of adoption revealed that consumption of duck products and rearing of ducks were the two most important variables influencing adoption of exotic duck in the study area (Table 2).

Table 1

The association between the predicting variables and adoption of exotic ducks

Predicting variables	Definition	Number of prospective adopters (%)	Chi-square (P-value)
State	Oyo (1)	128/218 (58.7)	15.46 (0.000)*
	Osun (2)	102/199 (51.3)	
Sex	Lagos (3)	38/107 (35.5)	9.86 (0.007)*
	Male (1)	183/325 (56.3)	
Age	Female (2)	86/199 (43.2)	9.49 (0.091)*
	11-20 years (1)	19/51 (37.3)	
	21-30 years (2)	64/136 (47.1)	
	31-40 years (3)	79/155 (51.0)	
	41-50 years (4)	65/111 (58.6)	
Occupation	> 50 years (5)		19.52 (0.003)*
	Artisan (1)	87/172 (50.6)	
	Trading (2)	14/21 (66.7)	
	Clergy (3)	102/185 (55.1)	
	Civil service (4)	18/23 (78.3)	
	Retiree (5)	46/119 (38.7)	
Marital status	Others (6)	¼ (25.0)	14.50 (0.002)*
	Single (1)	64/163 (39.3)	
	Married (2)	198/347 (57.1)	
	Widow (3)	4/9 (44.4)	
Religion	Divorcee (4)	2/5 (40.0)	1.54 (0.460)
	Islam (1)	60/109 (55.0)	
	Christianity (2)	200 (49.8)	
Education	Traditional (3)	8/13 (61.0)	0.352 (0.950)
	Primary (1)	23/42 (54.8)	
	Secondary (2)	67/135 (49.8)	
	Tertiary (3)	165/322 (51.2)	
	Non formal (4)	13/25 (52.0)	
Socio media	Yes (1)	141/253 (55.7)	4.12 (0.040)*
	No (2)	127/271 (46.9)	
Awareness of exotic duck	Yes (1)	142/222 (64.0)	25.33 (0.000)*
	No (2)	126/302 (41.7)	
Duck keeping	Yes (1)	52/60 (86.7)	34.22 (0.000)*
	No (2)	216/464 (46.5)	
Consumption of duck products	Yes (1)	216/340 (63.5)	59.43 (0.000)*
	No (2)	52/184 (28.3)	

*Only significant variables at P<0.10 were included in the final multivariate logistic regression

Table 2

Multivariate logistic regression model of relationship between predicting factors and adoption of exotic ducks

Independent variable	B	S.E.	Wald's X ²	P-value	Odds ratio {Exp (B)}	CI (95%)
State	0.429	0.133	10.456	0.001	1.536	1.184-1.992
Awareness	0.527	0.214	6.072	0.014	1.694	1.114-2.576
Consumption of duck products	1.156	0.219	27.928	0.000	3.178	2.070-4.881
Duck keeping	1.456	0.414	12.344	0.000	4.284	1.903-9.644
Constant	-7.816	1.361	32.983	0.000	0.000	-

B = Regression coefficient, S.E. = standard error of B, C.I. = confidence interval, Hosmer and Lemeshow test: X²= 5.286, P= 0.727; Overall correct prediction = 67.00%

Decision tree. The result of CRT was presented in Figure 2.

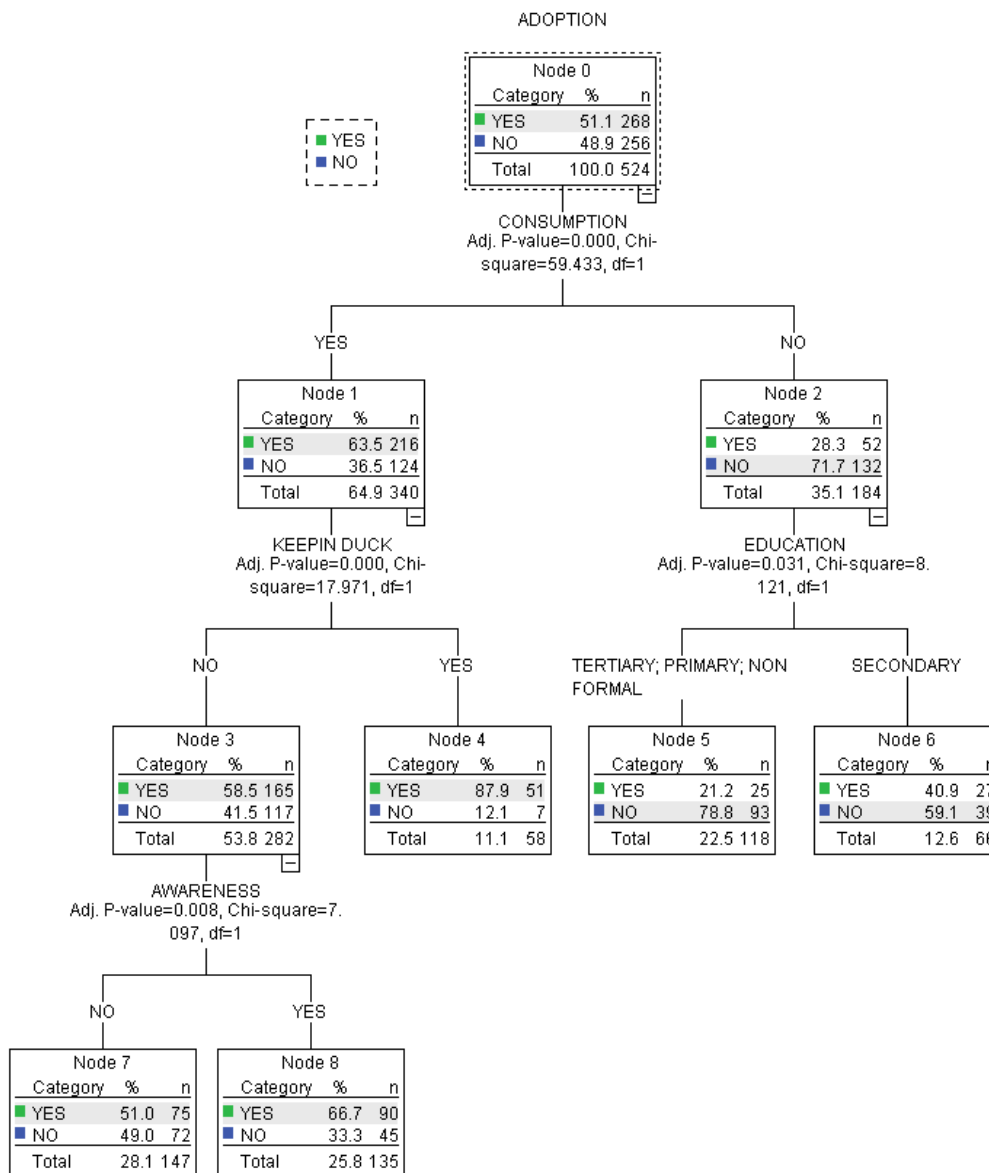


Fig. 2. Classification regression tree of determinants of adoption of exotic ducks

The root node (node 0) showed that about half (51.10%) of the respondents indicated interest in adopting exotic breeds of duck. The decision tree generated revealed further that of all the 11 hypothesised variables investigated, consumption of duck products followed by duck keeping, awareness on exotic ducks and educational qualification were the predictors of improved duck adopters. Of these four determinants of adopters, consumption of duck products and duck keeping were the

most important determinants. This is evident in increase in the proportion of prospective adopters to 63.50% and 87.9% for duck product consumption (Node 1) and duck keeping (node 4), respectively compared to 51.10% in the root node. Node 1 split into two child nodes, it implies that it is not terminal and that prediction or conclusion on the subject under study cannot be based on it. The root node branched into two (nodes 1 and 2) on the basis of consumption of duck products.

Respondents in node 2 split further into two homogenous and terminal nodes 5 and 6 on the basis of educational qualifications. While there was improvement (40.90%) in node 6 in the percentage of adopters of exotic ducks; there was a corresponding decrease in the proportion (21.7%) of adopters in node 5. The splitting variable for node 3 into twin terminal nodes 7 and 8 was awareness of existence of exotic duck. The predicted proportion of adopters of exotic ducks was higher (66.70%) in node 8 than what was observed in node 7 (51.00%). Nodes 4, 5, 6, 7 and 8 were terminal and this implies that they were homogenous and prediction on adoption could be based on them. Besides, the risk value and standard error of CHIAD was 0.336 and 0.021, respectively.

To the best of knowledge of the authors, the present study is the first to provide empirical report on determinants of adoption of exotic breeds of duck in Nigeria; thereby, limiting literature for critical comparison and validation of results presented. Adoption of new varieties of crops, breeds or strains of animals and farming technologies by farmers is controlled by complex synergistic effects of socio-economic, institutional and organizational factors among others.

Consumption of duck products (Egg and meat). The trend of result whereby consumption of duck products by respondents was the most important factor in predicting potential adopters of improved breeds of ducks in the study area is not unexpected. This is an indication that most of the respondents consuming duck products were ready to adopt improved breeds of duck. One of the possible reasons could be the avoidance of stigmatization associated with the handling, slaughtering, processing and consumption of the widely 'venerated' local ducks; since the retrogressive taboos and stigmas are not applicable to exotic ducks.

In addition, adoption of exotic ducks would help consumers of duck products to enjoy uninterrupted supply of duck products. This would help a lot in eliminating the problems associated with the dwindling population of local Muscovy ducks and its attendant effects, such as scarcity and higher price of duck and its products, most especially in dry season. The previous report of Joseph and Olanrewaju (1999) on duck product consumption revealed that unavailability was a major factor limiting duck consumption in north-central Nigeria. Another study that investigated the influence of seasonal variation on egg production of Muscovy duck in the study area corroborated the submission that uninterrupted supply of local Muscovy egg is limited to rainy season (April – September) but there was little or no egg production in dry season months (October – March) (Oguntunji *et al.*, 2015). Besides, respondents in this category need little or no persuasion to embrace duck products from improved breeds since they have been used to it compared to non-consumers.

Duck keeping. The underlying factors responsible for upsurge in the probability of adoption of exotic ducks by keeping of ducks (87.90%) compared to duck product consumers (63.50%) are multifaceted.

One of the principal factors making duck keeping the second most important factor in predicting potential adopters of exotic breeds of duck is the fact that most duck farmers primarily engaged in duck keeping because of consumption. Duck production in Nigeria is still at the stage of infancy (Oguntunji and Ayorinde, 2015a) and all production and marketing channels of duck and its products are neither organized nor standardized. These shortcomings are evidently reflected in perennial low demand for duck and its products. Besides, veneration of local duck and its products, stigmatization of local duck farmers and consumers have adversely affected its acceptance and production. The adverse effects of these factors contributed further to the skewness in its population distribution between urban and rural dwellers. While just few of them are reared in urban areas; preponderance of this waterfowl has been 'banished' to rural areas in southern Nigeria (Oguntunji and Ayorinde, 2015c). The skewness of higher proportion of this waterfowl in rural area has led to its relegation and classification as rural poultry in Nigeria. In view of this, most of the duck keepers in rural and urban areas involved in duck keeping do so primarily for consumption so as to enjoy continuous supply of duck products.

In addition, many duck farmers would like to adopt exotic breeds of duck in order to avoid hordes of taboos and myths connected with the rearing and marketing of the local Muscovy ducks. Since exotic ducks are not associated or affected with such backward 'laws', duck keepers are probably encouraged to adopt them in order to boost their sale and enhance expansion of the flock.

Another possible factor motivating readiness of adoption of exotic duck by duck keepers is the possibility of establishing specialized duck farms for meat and egg production in contrast to the dual purpose local Muscovy duck. At present, there is no breed or strain of Muscovy duck specially bred for meat or egg production in the study area and Nigeria in general; establishing a specialized duck farm would be possible because some breeds of exotic ducks have undergone intense genetic selection and have been developed to improve strains and varieties with track record of performance. For instance, exotic duck breeds such as "Khaki Campbell" and "brown 'Tsaiya'" are renowned egg layers while "Pekin" is universally known for meat production.

Furthermore, the possibility of the all-the-year-round egg production, increased hatching rate, and artificial incubation of higher number of eggs; thus, guaranteeing continuous supply of ducklings and duck products with attendant increased cash return are some of the possible salient factors motivating duck keepers in adopting exotic breeds of duck. These assertions are buttressed by a recent study by Oguntunji *et al.* (2015) that little or no egg production was recorded for intensively-reared Muscovy duck in dry season most especially in late dry sub-season (January – March). Similarly, another related study reported poor egg laying and poor hatching rate for Muscovy duck in traditional free range system in dry season when environmental temperature is elevated (Oguntunji and Ayorinde, 2015a).

Moreover, the possibility of rearing exotic breeds of duck under different management systems, most especially low cost extensive management system could be another factor motivating duck farmers to adopt exotic breeds of duck. Successful rearing under the prevalent harsh free range system would be of great financial relief in eliminating financial burden associated with pen construction, feeding and labour involved in keeping duck intensively since duck farming is not a full time job.

Awareness. The observed increase in the likelihood of adoption of improved breeds of duck through awareness is the product of years of aggressive awareness campaigns by NGOs, farmers' forum, Agricultural Development Programmes and extension agents on the availability and possibility of rearing exotic breeds successfully under local conditions.

Awareness on existence of exotic duck also increased the chances of adoption. Recently, ignorance of existence of exotic duck was identified as one of the reasons for not keeping them by duck farmers in Nigeria while few that were aware did not know how to get them and or were not interested in them at all (Oguntunji and Ayorinde, 2015b).

In addition, awareness on their unique genetic attributes such as fast growth rate, higher egg production, availability of different breeds and most importantly, 'immunity' from the hordes of taboos and exclusion from religious and rituals roles associated with the local Muscovy ducks might also be some salient factors increasing their chance of adoption among duck product consumers. Awareness campaign is a principal tool contributing to the acceptability and increased demand of a product.

State. The disparity observed among the respondents in the three states under investigation on probability of adoption of improved breeds of duck was not unexpected. Oyo and Osun States with higher proportions of would-be adopters are predominantly agricultural states. Majority of the residents in the two states rely on agriculture and allied industries for their livelihood; hence higher propensity to adopt exotic breeds of duck. Conversely, Lagos State with the least proportion of interested respondents to adopt exotic duck was the former capital city but still remains the chief industrial and commercial city of Nigeria. The huge capital investment in diverse commercial activities and industrial nature of the state might not make rearing of duck an attractive investment compared to the agrarian states.

The observed disparity in interest to adopt exotic ducks in the investigated states implies that for effective introduction and adoption of improved varieties of duck, policy makers on distribution of animal genetic resources should focus on agrarian communities where it would be appreciated and accepted.

Implication of adoption of exotic ducks in Nigeria on indigenous duck genetic resources

The interest shown by the respondents in adopting exotic ducks demonstrated their interest in rearing exotic ducks and the possibility of introducing them to the study area and Nigeria at large. Nevertheless, introduction of the improved breeds should be handled with caution. This is because the influx and adoption of exotic ducks on large scale could lead to further decimation of local Muscovy ducks; thus, endangering them in Nigeria. Empirical report have indicated that population of this indigenous waterfowl is on decline in recent years in Nigeria (Ogah and Ari, 2012). Adoption of foreign breeds of duck on large scale could also lead to the utter neglect of indigenous ones; thus, accelerating 'erosion' of the adaptive genes inherent in them over the years. Indigenous livestock species are repository of valuable genes for survival and adaptation to harsh climatic conditions, inadequate feeding and resistance to endemic diseases and parasites compared to the target-trait-selected genotypes. Therefore, concerted efforts are needed to preserve their valuable genes.

Furthermore, since the age-long challenge of sterility of hybrids of Muscovy and Common ducks remains unresolved; this practically ruled out the possibility of harnessing the genetic potentials of the two duck *genera* for the production of meat and egg hybrid lines. Nonetheless, this suggests the need to consider alternative platform for policy makers on livestock production by organizing pilot studies on genetic improvement of local Muscovy duck (LMD) and production of its tropically-adapted egg and meat lines. This would not only help in conserving huge foreign exchange invested in importing exotic strains and attendant problems of acclimatization, but also contribute immensely to the conservation of the valuable germplasm of LMD from genetic 'erosion'.

In addition, collaborative investigative studies are to be conducted by livestock stakeholders and animal breeders to identify the needed phenotypic 'modifications' capable of motivating and encouraging adoption and rearing of indigenous Muscovy ducks. In addition to the widely acknowledged taboos and superstitions hamstringing commercial production and demand for duck products; a recent study by Oguntunji and Ayorinde (2015c) have shown that plumage colour influences the choice of duck and or number of duck reared by duck farmers. These authors stated further that solid black and white animals, most especially birds, are usually linked with gods/spirits and rituals in Nigeria. Black colour is usually associated with evil or bad omen in south-west Nigeria, and solid black animals such as cats, pigeons, chickens, dogs and sheep are 'tagged', linked with spirits and commonly avoided like a plague (Oguntunji, 2014). This might probably be the underlying reason for the prevalence of mottled (mixed white and black plumage) Muscovy duck compared to solid white and solid black counterparts in the study area (Oguntunji and Ayorinde, 2015c). The necessity of 'phenotypic modification' in enhancing adoption of local Muscovy duck was corroborated by the submission of Okeno et al. (2011) that the development of a breeding goal for improvement of indigenous stock should focus on the traits perceived important by stakeholders. This is because when breeding goals are developed without considering the needs of all the stakeholders, there are high tendencies of being rejected by end users (Yakubu and Achapu, 2017). In view of the foregoing, studies on trait preference among duck farmers and members of the public are imperative to guide animal breeders, relevant non-governmental organizations (NGOs) and governmental agencies saddled with the responsibility of introduction, production and distribution of animal genetic resources.

Furthermore, joint efforts of animal breeders, livestock research institutes and breeding companies are also needed to investigate and explore sex-linked traits such as plumage colours that could be exploited for production of sexed day-old Muscovy ducklings. It is worth emphasizing that a major landmark achievement in animal breeding in the last century resulting in unprecedented revolution of poultry industry; most especially in commercial egg layers was the mass production and distribution of sexed day-old chicks. This monumental achievement was a product of intense selection via the application of the knowledge of sex-linked inheritance. Therefore, identification and exploration of sex-linked sexual dimorphic traits identifiable at day-old would be of immense contribution to industrial production of indigenous local Muscovy ducks.

The introduction of exotic ducks cannot be totally ruled out considering the expressed interest of the respondents to adopt if available. This implies further that

studies are needed to investigate the most demanded duck product(s) (meat and egg). The findings of such studies would be invaluable to animal breeders, breeding companies, research institutes and commercial hatcheries in identifying breeds or strains of improved duck to introduce. The findings would also guide animal breeders in advising stakeholders involved in livestock production on where to source for the improved varieties. Though genetic attributes of an animal play a significant role on performance; nevertheless, it is noteworthy that rearing environment encompassing both biotic (parasites, pathogens etc.) and abiotic (meteorological indices, drugs, vaccines, feed etc.) factors among others also contribute substantially to the overall performance of animals. Sourcing for genetically-improved breeds of ducks from similar tropical or sub-tropical environment would go a long way in enhancing adaptation; thus, mitigating attendant challenges of introduction and acclimatization of exotic ducks from temperate region to hot tropical environment and inestimable financial/economic loss commonly incurred through disease infections and mortality.

Considering the ‘battered image’ of LMD in Nigeria, it is instructive to note that there is a need for collaborative action by animal breeders, extension agents, poultry farmers, NGOs, nutritionist, psychologists, media practitioners, stakeholders on animal agriculture etc. to chart a new course to disabuse the ‘poisoned’ minds of the public against ‘demonized’ indigenous Muscovy ducks. Most importantly, such campaigns would also sensitize the public on the grave danger associated with the ‘genetic erosion’ of their valuable genes via neglect. Such synergistic effort would help further in enlightening the public on the nutritional and economic benefits connected with the rearing and consumption of its products. This submission is in agreement with the earlier suggestion (Oguntunji, 2014) that aggressive awareness campaign should be organized to combat the damaging effects of the retrogressive taboos and superstitions attached to Muscovy ducks.

CONCLUSIONS

The study demonstrated that consumption of duck products and duck keeping were the two most important factors in predicting potential or identifying would-be adopters of exotic breeds of duck in south-west Nigeria.

Considering the two principal variables predicting would-be adopters of exotic duck, it is evident that the likelihood of adoption of exotic duck is hinged on consumers of duck products and duck keepers. This is instructive that intense awareness campaigns through public lectures, farmers’ forum, extension agents, print and electronic media, etc. are needed to re-orientate the public on the economic and nutritional benefits of this waterfowl. Also, there is a need to disabuse the ‘poisoned’ minds against duck and its products. Since introduction and adoption of exotic ducks appear inevitable in the study area; concerted efforts of animal breeders and stakeholders on livestock production are needed to guard against impending ‘genetic erosion’ of local Muscovy duck through conservation programmes.

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