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THE PRODUCTIVE PERFORMANCE OF LOCAL CHICKENS IN THREE ECOLOGICAL ZONES OF GHANA

J. K. Hagan[1], M. Bosompem[2] and I. A. Adjei[3]
[1]Department of Animal Science, School of Agriculture, University of Cape Coast, Ghana
[2]Department of Agricultural Economics and Extension, University of Cape Coast, Ghana
[3]Department of Mathematics, KNUST, Kumasi, Ghana
E-Mail: kofihagan30@gmail.com

ABSTRACT

A survey was carried out in three agro-ecological zones (coastal savannah, rain forest and guinea savannah) of Ghana to find out the productive performance of local chickens. A total of 180 local chicken keepers (60 each from the three zones) were randomly selected with the help of the Agricultural Extension Agents in the zones. Data were collected through the administration of pre-tested semi-structured questionnaires, direct observations and measurements of productivity indices. Data collected included clutch sizes, number of clutches per year, egg production per year with and without hatching, age at sexual maturity, flock size and composition, hatchability and chick survival rates. Egg and body weights of birds were measured. Results obtained showed an average flock size per household of 17.5, 24.3 and 11.7 for the coastal, forest and savannah zones respectively, with an estimated inbreeding coefficient of 0.04. The mean clutch number was 3.0 with a clutch size of 12.8 eggs. The local birds were found to reach sexual maturity at 5.7 and 6.4 months for cocks and hens respectively. The annual egg production with hatching was 38 eggs with an egg size of 41.3g and 84.5% hatchability rate. The birds were found to be reared under the traditional extensive system with little or no care. Diseases (Newcastle), predation and theft were found to be the main causes of loss of bird or reduction in flock size. It is advocated that extra effort in the management and improvement of local chickens in the areas of housing, breeding, feeding and health care can go a long way to improve the productive performance of local chickens in Ghana.

Keywords: local chickens, clutch number, clutch size, ecological zone, flock size.

INTRODUCTION

According to Aboe *et al.* (2006), although indigenous village chicken is the most prominent class of livestock in the country and constitutes about 60-80% of the total poultry population, their productivity is low because of poor nutrition and low genetic potential. The local chicken production systems in Africa are mainly based on scavenging indigenous chickens found in almost all households in the rural areas. They are characteristically an integral part of the farming systems requiring low-inputs with outputs accessible at both inter-household and intra-household levels (Kitalyi, 1998). Rural poultry production is an important agricultural activity of almost all rural communities in Ghana providing scarce animal protein in the form of meat and eggs as well as being a reliable source of petty cash. According to Alders and Spradbrow (2000) village chickens also fulfill a number of other functions for which it is difficult to assign any monetary value. These include the fact that rural chickens play an active role in pest control and are used for traditional ceremonies and festival.

According to Islam (2000), indigenous chicken meat and eggs are preferred by majority of rural dwellers mainly because of their toughness, pigmentation, taste, leanness and suitability for special dishes. There is also a high demand for the meat by the urban dwellers but the supply is limited due to the low productivity. A better integration and improvement of livestock production into the small farm enterprise could contribute significantly to the improvement of the livelihood of small farmers (Davendra and Thomas, 2002). Small scale livestock development, particularly native chicken keeping, is normally considered as the most feasible option for poor small scale farmers (Phalarak, 1985). The sustainability of the native chicken rearing is also higher in terms of the adaptation of the chickens to the local environment, poor feed resources and their disease resistance. The objective of the work was to assess the management and productive performance of local chickens in some selected villages in three ecological zones of Ghana.

MATERIALS AND METHODS

The study was conducted in 180 randomly selected households in three ecological zones (coastal savannah, rain forest and guinea savannah) of Ghana. In the coastal savannah zone, the survey was carried out in the Abura-Asebu-Kwamankese, Gomoa West and Komenda-Edina-Eguafo-Abirim districts, and while in the rain forest zone the survey was done in the following districts: Bia, Sefwi-Akontombra and Joaboso. In the case of the guinea savannah, the following districts were used: Bongo, Builsa and Garu-Tempane. The coastal savannah zone is characterized by sandy beaches and marshes with land rising between 250m and 300m above sea levels. The zone lies between the dry equatorial and moist semi-equatorial zones with an annual rainfall ranges from 1000m along the coast and about 2000m in the interior. It lies within latitude 514 north and 535 north and longitude 022 west and 054 west. The wettest months are May-June and September-October while the drier periods occur in December- February and a brief period in August. Mean

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monthly temperature ranges from 24^0C in the coolest month (August) to about 30^0C in the hottest months of March-April (MoFA, 2005).

The rain forest zone on the other hand is noted for its rain forest, interspersed with patches of mangrove forest along the coast and coastal wetlands, while a large expanse of high tropical forest and semi-deciduous forest is also found within the zone. The area lies in the equatorial climatic zone that is characterized by moderate temperatures, ranging from 22°C at nightfall to 34°C during the day. It is the wettest part of Ghana, with a double maximum rainfall pattern averaging 1, 600 mm per annum. The two rainfall peaks fall between May-July and September/October. In addition to the two major rainy seasons, the zone also experiences intermittent minor rains all the year round. This high rainfall regime creates much moisture culminating in high relative humidity, ranging from 70 to 90 per cent in most parts of the region.

The guinea savannah zone on the other hand lies between longitude 00 and 10 West and latitudes 100 30N and 110N. The natural vegetation is that of the savannah woodland characterized by short scattered drought-resistant trees and grass that gets burnt by bushfire or scorched by the sun during the long dry season. The most common economic fruit trees are the sheanut, dawadawa, boabab and acacia. The climate is characterized by one rainy season from May/June to September/October. The mean annual rainfall during this period is between 800mm and 1, 100mm. The rainfall is erratic spatially and in duration. There is a long spell of dry season from November to mid February, characterized by cold, dry and dusty harmattan winds. Temperatures during this period can be as low as 14^0C at night, but can go to more than 35^0C during the daytime. Humidity is, however, very low making the daytime high temperature less uncomfortable (MoFA, 2005).

A Participatory Rural Appraisal technique aimed at getting an overview of the production and management of local chickens was conducted in 180 households through random sampling method; 60 households in each zone. A list of villages in the zones was drawn up with the help of the Agricultural Extension Agents after which ten (10) villages were randomly selected and six (6) households in each village selected based on whether the household kept local chickens or not. A total of 180 farmers who were directly involved in the care and management keeping of the chickens were individually interviewed using pre-tested semi-structured questionnaires (60 in each zone). The productivity parameters measured included clutch sizes, number of clutches in a year, egg production per year with and without hatching, age at sexual maturity, hatchability, and chick survival rate. Clutch number was estimated as the number of times the hen comes to lay in a year.

Additional data were obtained by direct measurement of the productivity and on-spot observations depending on the availability of such indices at the time of the farm visits. Field notebooks were used to record all relevant information such as flock composition and size, management systems (housing, feeding, health care), loss of birds, flock performance and utilization of chickens and also the farmers were given notebooks to record any findings that occurred in-between visits. Information about the housing system was obtained by direct observations of the chicken houses and the evaluation of feed quality and other equipment made. Disease situations were identified by the farmers according to the local names and description of the symptoms and sometimes by consulting the extension/veterinary personnel who accompanied the researchers. The villages were chosen such that they were some kilometers away from one another so that flock from one village could be considered as different breeding populations. To get an impression of the viability of the chicken populations, the effective population size (N_e) per breeding population was estimated which consequently enabled the researcher to estimate the rate of inbreeding (ΔF) using the equation given by Falconer and Mackay (1996).

$$N_e = \frac{4N_m N_f}{N_m + N_f}$$

Where N_m is the number of breeding cocks and N_f is the number of breeding hens in the breeding population. Rate of inbreeding (ΔF) was therefore estimated according to the formula:

$$\Delta F = 1/2N_e$$

Because the study did not cover a full year, annual egg production was estimated from clutch sizes and clutch number per hen. Egg and body weights were measured using a 2kg-capacity top-loading electronic scale. In each flock, a sample of 10 eggs was weighed whereas the birds were weighed individually, by tying their wings and legs and then placing them on the scale. The eggs were weighed in groups of ten and the average weight in grams taken. Hatchability was calculated as the number of chicks hatched divided by total number of eggs set expressed as a percentage. Survivability was calculated as the number of chicks that chicks that reached sexual maturity divided by number of chicks hatched expressed as a percentage.

The data obtained were analysed using the statistical procedure of SPSS version 12. Frequency counts and means were calculated according to the type of dataset. With respect to the productive and reproductive parameters, the general linear model (GLM) procedure was used and pair-wise comparison was carried out using the Turkey method. Multivariate analysis was carried out to investigate how similar or different the chicken populations in the different ecological zones were.

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RESULTS AND DISCUSSIONS

Table-1. Mean (± s.e.) flock size, effective population size and level of inbreeding of local chickens in the three zones.

Category	Statistics	Ecological zones			Overall mean
		Coastal	Forest	Guinea	
Chicks	Range	4-27	5-36	2-12	
	Mean	10.2±4.9[b]	11.2±7.0[a]	9.7±4.3[b]	10.3
Pullets	Range	2-7	1-9	3-9	
	Mean	3.9±1.9[b]	3.6±2.8[b]	6.3±2.2[a]	4.7
Cockerels	Range	1-6	1-7	1-9	
	Mean	4.0±1.9	3.0±2.7	4.3±1.9	3.7
Hens	Range	4-25	2-22	3-15	
	Mean	9.5±5.4[a]	7.3±5.7[b]	9.1±3.7[a]	8.6
Cocks	Range	2-15	2-15	2-8	
	Mean	5.1±2.9	4.6±3.2	5.0±1.9	4.9
Total flock size	Range	10-25	12-36	8-15	
	Mean	17.5±1.8[b]	24.3±2.1[a]	11.7±2.5[c]	18.3
Cock: hen ratio		1: 1.5	1: 1.1	1: 1.4	1: 1.3
N_e		13.3	11.3	12.9	
ΔF		0.038	0.044	0.039	

Note: N_e **:** effective population size, ΔF inbreeding coefficient; Means within a row with common superscripts are not significantly different (P>0.05) at 5% level of significance.

In the present study, there were significant differences (P<0.05) in flock sizes among the various ecological zones for chicks, pullets and hens owned by the households, with households in the forest zones having significantly (P<0.05) the highest flock size followed by coastal and savannah zones (Table-1). The mean flock sizes obtained for households in the coastal and savannah zones were lower than values of 22 and 28.7 recorded by Adomako *et al*. (2009) and Aboe *et al*. (2006) for local chickens in the Forest zone and Accra plains region, respectively. The reasons being that flock size varies with seasons mainly due to the availability of feed, the occurrence of diseases, the presence of predators as well as the socio economic status of the owners (Mogesse, 2007). The cock hen ratio of 1: 1.3 was comparable to values of 1:1.9 and 1:1.5 recorded by Dankwa *et al*. (2003) and Adomako *et al*. (2009) for local chickens in Ghana. The cock hen ratio was calculated based on the number of breeding hens and cocks available during the study period. The cock-hen ratio was far below the recommended ratio of 1:8-10 for mating and this could be attributed to the lack of knowledge on chicken management and breeding by rural farmers. The cocks were underutilized and there is the need to eliminate some by either selling or consuming them to ensure proper utilization of cocks.

The effective population size ranged from 11.3 to 13.3 with an inbreeding coefficient of 0.04. The effective population size gave an idea as to the level of inbreeding in the chicken populations in the various zones using the flocks of farmers who possessed their own breeding males. With this, it was realized that coastal zone recorded the highest effective population size followed by savannah and then forest zones. However, the level of inbreeding recorded in the three zones was similar. The effective population size for the local chicken populations obtained in this present study is higher than that obtained by Nigussie *et al*. (2010) who found values in the range of 3.19 and 5.22 for local chickens in Ethiopia. Due to the relatively large flock size obtained in the various ecological zones, the rate of inbreeding is moderately low. The rate of inbreeding is influenced by the number of breeding individuals per household. Due to the possibility of the absence of breeding males in some households and the uncontrolled manner of natural mating among village chickens, the estimates on the effective population size as well as the rate of inbreeding might not be accurate.

The productive performance of the local chickens in the three ecological zones are similar (P>0.05). Pullets and cockerels in this present study reached sexual maturity at an average age of 6.4 months and 5.7 months,

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respectively (Table-2). These values are similar to that reported by Dankwa *et al*. (2003) for local chickens in Ghana but better than those obtained by Mogesses (2007) for Ethiopian local chickens (7-8 months), Wilson (1979) for Sudan's local chickens (8 months) and Katule (1992) for Tanzania's local chickens (7 months). The delayed sexual maturity observed for local chickens in the present study might be as a result of poor management (where almost all the farmers kept their flock under the extensive system) and lack of intensive selection among local chickens. The present study showed that, a breeding female produced on average 38.2 eggs annually when the hen hatched its own eggs and brooded its own chicks. Dankwa *et al*. (2003) reported 35 eggs annually which are lower than the value obtained from this study. The significant difference in estimated annual egg for local chickens in the different ecological zones must be due to different climate conditions associated with the zones. The differences in annual egg production might also be due to differences in how the birds were managed by the care-takers and the availability of scavengable feed resource base in the various locations. According to Kitalyi (1998) the productivity of village chickens is determined by the relationship between the biomass of the chicken population and the scavengable feed resource base (SFRB). The SFRB is affected by the human population and the closeness of the households. The mean clutch number was 3.0 with mean clutch size of 12.9 eggs. This is within the range of 3-4 clutches and the clutch size range of 11-15 eggs reported by Aboe *et al*. (2006) for local chickens in the Accra Plains of Ghana. Bourzat and Saunder (1990) also reported 2.7 to 3 clutches for local chickens in Burkina Faso.

Table-2. Mean (± s.e.) productive performances of the birds in the three zones.

PARAMETERS	**Coastal** n = 60	**Forest** n = 60	**Guinea** N = 60	**Overall average**
Age at sexual maturity				
Pullets/ months	6.5±0.2	6.3±0.4	6.3±0.3	6.4
Cockerels / months	5.5±0.1	6.1±0.3	5.4±0.2	5.6
Annual egg production with hatching / (n)	39.5±7.2[a]	37.5±5.8[b]	37.8±5.5[b]	38.7
Annual egg production without hatching/ (n)	69.9±5.4[a]	66.7±4.6[b]	69.5±4.6[a]	68.3
Clutch number/ (n)	3.0±2.2	3.0±2.2	3.0±2.2	3.0
Clutch size/ (n)	13.2±2.4	12.6±1.9	12.6±1.9	12.9
Egg weight (g)	41.6±2.9	40.5±3.1	41.0±4.2	41.3
Body weights/ kg				
Pullets	0.91±0.1	0.88±0.1	0.89±0.1	0.9
Cockerels	1.1±0.1	1.0±0.1	1.1±0.1	1.1
Hens	1.3±0.1	1.3±0.1	1.3±0.1	1.3
Cocks	1.8±0.1	1.7±0.1	1.7±0.1	1.7

n: the number of households; means in a row with common or no superscripts are not significantly different (P>0.05) at 5% level of significance.

The mean egg weight of 41g obtained from this study is similar to the value of 42.8 g reported by Adomako *et al.* (2009) for local chickens in the Ashanti region of Ghana. The mean weight of pullet (0.89kg) and cockerels (1.1kg) were comparable to values of 0.86kg and 1.03kg for pullets and cockerels obtained by other authors in some African local chickens (Chemjor, 1998; Olwande *et al*., 2009). In an earlier study by Dankwa *et al*. (2003) on local chickens in Ghana they reported a relatively higher body weight of 1kg and 1.3kg for pullets and cockerels, respectively. The mean live weights of hens and cocks of 1.31kg and 1.73kg in this present study however fall within the weight range of 0.9-1.6 kg and 1.2-2.3 kg reported by (Adomako *et al.*, 2009). There were however no significant differences (P>0.05) in live weight of the chickens among the three ecological zones, an indication of similar genetic make-up of local chickens kept by local farmers in Ghana. Results from the present study revealed low productive capabilities of local chickens in the study areas. This could be due to the extensive system that was employed by all the keepers in the study area, characterized by little or no investment in feeding, medication and housing. This normally results in low productivity. Local farmers are therefore advised to invest in the production of local chickens by way of improved feeding, housing and health care so to realize the full genetic potential of these birds.

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Table-3. Mean (±s.e.) reproductive performances of the birds in the three zones.

Parameters	Coastal n = 60	Forest n = 60	Guinea n = 60	Overall average
Eggs set for hatching	10.9±2.2	9.4±1.0	10.5±2.7	10.3
Number of chicks hatched	9.2±2.0	7.5±0.9	9.3±2.2	8.7
Percentage hatchability	83.6±8.7[b]	80.2±9.6[b]	89.6±8.3[a]	84.5
Number of chicks reaching 8 wks.	5.9±2.1	6.7±1.2	7.2±2.6	6.6
Separation age (weeks)	7.3±0.5	7.9±0.6	8.3±1.2	7.8
Chick mortality/%	49.9±4.2[a]	28.7±3.2[b]	31.4±3.1[b]	36.6

n: the number of households; means in a row with common or no superscripts are not significantly different (P>0.05) at 5% level of significance.

Interaction with the local keepers showed that fertile eggs were hatched by broody hens. The average number of eggs incubated by the broody hens was 10.3 out of 12.8 eggs laid per clutch per hen. The number of eggs set for hatching was determined by the past performance and the body size of the hen. A comparatively high number of chicks (8.7) were hatched from the number of egg set with a percentage hatchability of 84.5%. Similarly, Osei-Amponsah *et al*. (2009) reported a percentage hatchability of 87.8% for local chickens in the chicken ecotypes of the forest and savannah zones. The differences (P<0.05) in percent hatchability recorded in the different zones might be due to different treatments given to broody hens during hatching. The inherent characteristics of broody hens might also be a contributing factor as far as natural incubation is concerned. Apart from the high percent hatchability of eggs of local chickens, their productivity is comparatively low and this is as a result of low investment associated with their production. The high percent chick mortality experienced was due to predation and diseases. Farmers within the coastal zone reported of an outbreak of Newcastle diseases which killed most of the birds; hence the significantly high percent chick mortality recorded. Chick mortality has been reported to be the major cause of loss of flock size among local chickens (Kitalyi, 1998). Vaccination of chicks especially against one of the major killer diseases, Newcastle has been found to be effective in controlling chick mortality. The present study also identified other constraints to local chicken production; prominent among them were poor housing, poor nutrition and low investment, albeit low productivity.

CONCLUSIONS

It could be concluded that local chicken production is an important enterprise and contributes immensely to family income and protein malnutrition reduction. The productivity of the local chickens in the study areas are however low due probably to low investment, poor management, predation, diseases and low genetic potential of the birds. The significant differences in some productive performance characteristics of the local chickens in the different ecological zones is an indication of possible genetic diversity existing in local chickens in Ghana, hence the need to exploit this attribute for future local chicken improvement. The high percent chick mortality observed in this study is worrying duet to its implication on flock size and flock perpetuation.

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