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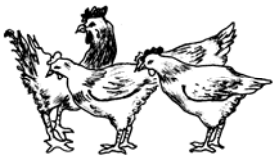

CONTENTS

Editorial

INFPD Newsletter becomes *Family Poultry*

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Providing appropriate technical information and advice is one of the major leverages to achieve sustainable family-related poultry development. Since its setting-up in November 1989, our Network (formerly known as 'African Network for Rural Poultry Development' before changing its name to 'International Network for Family Poultry Development' or INFPD in December 1997) has been publishing a trilingual (English, French and Spanish) Newsletter, which has been produced twice a year and distributed electronically with a printed version for members without e-mail facilities. Readership of the Newsletter has increased significantly parallel to the wider coverage of the network membership that have been extended to Asia, Latin America and Oceania. The current subscriber list reveals that there are presently more that 750 INFPD members from 103 countries in five continents. Since the Newsletter is made available on the Internet, it can however be assumed that its readership is much larger. Moreover, the network's activities to be published in the Newsletter have been focusing not only on rural areas but also on other poor areas, like the urban and peri-urban ones. Research and development actions on other poultry species (e.g. ducks, geese, guinea fowls, turkeys, quails and pigeons) were also strongly encouraged. In short, relevant data and information collected on all aspects of family poultry (FP) production systems have been disseminated to FP actors through the Newsletter.

In September 2006, some of the INFPD key members, supported by members of the Committee of World's Poultry Science Association, suggested to further upgrade the status of INFPD Newsletter, especially as now all articles submitted for publication are peer reviewed. In order to have the opinion of INFPD members, a small e-consultation was run on 21 February 2007. Members were asked whether they agree with the idea. If yes, they were invited to suggest their preferred new title for our publication. Results of the e-consultation indicated that 56 out of the 60 INFPD members who replied had welcomed the change. The reasons mentioned by respondents for supporting the change include the following: (a) higher rating of published papers, (b) more contributors, particularly development workers, lecturers and researchers, (c) international recognition of the publication that would attract funding from other sources, and (d) income generation to support the secretariat through the sale of papers.

For the new title of our publication, numerous suggestions were made by 40 members (out of the 56 members who welcomed the change). One of the most relevant suggestions is that the word 'journal' does not appear in the new title of the INFPD publication, as is the case for many other important journals. Moreover, the new title to be chosen for our publication should (a) not conflict with any other registered titles, (b) be clearly recognisable in electronic searches, and (c) be clear and concise (a long title would take up too much space in lists of references). Thus, the following title was preferred:

Main head: FAMILY POULTRY

Sub-head: Published by the International Network for Family Poultry Development

I hope you concur with this change. Every effort will be expended to make sure that all INFPD members are associated with this challenging development. Our aim is also to attract more poultry scientists and other livestock specialists into the field of family-related poultry production systems. While continuing to provide information to frontline FP actors, it is thought that our publication will carry more weight for readers and better recognition of its status as a peer-reviewed scientific publication for potential contributors. This is a difficult compromise to make, but we are confident since we can count on the support and assistance of all INFPD members and others, for example, through the preparation and submission for publication of articles and reports resulting from their research and development works on FP. Since our reviewers are well familiar with FP issues, they are more capable of understanding the specific conditions under which research and development works on FP are done.

Happy and thoughtful reading!

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RESEARCH REPORT No 1:

Guinea fowl rearing constraints and flock composition under traditional management in Borgou Department, Benin

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Summary

A survey was conducted in Borgou department (northern Benin) to characterize Guinea fowl production systems in rural areas. A questionnaire was administered to 70 Guinea fowl keepers in order to collect information about Guinea fowl management and husbandry practices in the region. This activity was practised according to traditional management in Benin where free range is the most common system of rearing. Birds scavenged during the day while at night, keets and surrogate hens were housed in poor, cramped coops whereas adult Guinea fowls roosted on trees. No rational feeding system was practised. Guinea fowls gleaned grass seeds, vegetable leaves, insects, worms, bones and eggshells. Poultry received a supplement consisting of cereals and their by-products, e.g. sorghum (30.4%), maize (25.0%), rice (14.3%), maize bran (7.1%), kitchen waste (5.4%), sorghum bran (3.6%), millet (1.8%) and complete food (1.8%). Adult body weight was 1121.3±100.2g at 6 months and maximum growth rate of 10.2g/day was reached at four months. Point-of-lay was between 7 and 9 months. Local hens were used to incubate Guinea fowl eggs, and hatchability was 72.9%. The survey revealed that Guinea fowl productivity is low because of high keet mortality. Average keet mortality registered from 0 to 6 months was 48% (range 3 to 100%). Moreover, 74% of interviewed farmers reported that keet mortality constituted the major constraint to Guinea fowl rearing. Others reported constraints, included keet weakness, poor quality of eggs, egg losses hidden under brush, keets predation, poor housing and infestations. The size of the keet populations varied over the year with the highest proportion in June-July while the proportion of growers increased from September to January.

Keywords: Guinea fowl; productivity; traditional; scavenging; Benin; constraints

Introduction

Guinea fowl (*Numida meleagris*) is an important component of local poultry reared under extensive production systems in northern Benin. In Borgou region, a rural family owns on average 18 Guinea fowls (Laurenson, 2002). However, formal knowledge about traditional free-range Guinea fowl production is still limited despite the importance of its contribution to total rural poultry income. Apart from their main use as sources of income and protein, Guinea fowls also play an important role in the social life of many tribes in Benin such as the *Ditamari*, where they are exclusively used for their annual festival and offered to honoured guests (Dahouda, 2003). Compared to chickens, Guinea fowls are economically more suitable to tropical regions because of their adaptation to traditional breeding. They have a greater ability to survive under poor conditions of management than the exotic chickens (Agwunobi, 1984). They allow farmers to diversify and bring in cash mainly for eggs and sometimes meat because of its short cycle of production (Chrysostome, 1995, 1997; Mopate and Lony, 1998). Guinea fowl production represents therefore a commercial opportunity for rural and peri-urban farmers; their promotion is important in Benin.

This study aims to evaluate the Guinea fowl population and their productivity under traditional management in Borgou area as well as to identify the main constraints to their production.

Material and methods

The study was carried out in Parakou (Borgou Department, Northern Benin), characterized by soudano-guinean climate with a rainy season from April to October, reaching torrential levels in September. There is a dry season for the remainder of the year. Annual rainfall in the area varies from 900 mm to 1200 mm and extreme average temperatures are 30.8°C in February (dry season) and 24.4°C in August (rainy season).
The vegetation is Savannah. An extensive mixed crop-livestock system is adopted by nearly 60% of the population, with cotton as a cash crop, and maize and millet are grown for home consumption. The economy is essentially based on the agricultural sector. Rural families preserve a type of traditional exploitation characterized by a low output. The keeping of domestic animals, which plays an important role in families, represents only 6.2% of the Gross Domestic Product (GDP).

Two methodological approaches were used in this study. Firstly, a transversal survey was performed on Guinea fowl productivity under scavenging management in 15 villages located in Parakou Communal area. The survey was carried out during three months and based on a questionnaire administered to 70 Guinea fowl keepers randomly chosen (*Table 1*). Secondly, a longitudinal study concerned Guinea fowl growth performance and flock structure at rural farmer level. The farms were visited every three days and the data collected including keets' live weight measured at days 1, 7, 14 and months 1, 2 up to 6, as well as breeders and flock size and composition. Appropriate balances were used for weighing the animals according to their age.

Table 1 Information collected from transversal study (70 keepers) in Parakou farms in Benin.

Farmer identification	**Name, age, sex, locality, ethnic group**
Management	Traditional vs modern, free-range, semi-scavenging or confining
Feeding system	Supplementation or not, timing, feed types (leafs, seeds, termites), water hygiene
Breeding	Mating ratio, age point-of-lay, time points of laying, number of eggs incubated, number of hatched eggs, average number of eggs laid per female, incubation dates, hatching dates,
Flock structure	Size, classes (keets, growers, etc.)
Sales and marketing	Prices, ages, marked periods, profits
Constraints to breeding	Keets (mortality, weakness, predation), eggs (quality, losses), intoxications, etc.

Results and discussion

Characteristics of Guinea fowl production under traditional management in Borgou area

The study revealed that men owned more Guinea fowl flocks than women (87 vs 13%). Saina (2005) and Bounkoungou (2005) found similar results in Zimbabwe and Burkina Faso, respectively. Ages of Guinea fowl keepers ranged between 25 and 60 years. Various Guinea fowl housings were observed during the present study. These coops were cramped, badly ventilated, dirty and did not ensure adequate protection against predators, exposing the animals to a high degree of hazard.

Guinea fowl rearing is usually characterized by traditional management in Benin where the free-range is widely practised. This scavenging production system is similar to that adopted by smallholder poultry farmers in most sub-Saharan African countries (Idi, 1998; Dahouda, 2003; Saina, 2005). It is integrated with crop and livestock production where several poultry species are mixed (Bounkoungou, 2005) predisposing animals to sickness. Overnight, keets with surrogate hens and chicks are housed in poor chicken coops, in kitchens or under a granary while adult Guinea fowls roost on trees during the night. In this context, they are difficult to capture and sometimes can escape and vanish in the brush as Guinea fowls are only partly domesticated. According to Bessin *et al.* (1998), 9% of Guinea fowls in Burkina Faso are reared in a complete free-range management system while the others are housed in traditional (80%) and modern (11%) houses.

Feeding

As expected in traditional management, no rational feeding system was practised by the farmers from Borgou. They allowed the birds to scavenge for most of their feed around the village. Guinea fowl feed on a wide range of flora and fauna. Under the traditional free-range system, Guinea fowls are good scavengers and often cover a great distance from home in search of feed (Nwagu and Alawa, 1995). In addition to supplementary feedstuffs received from farmers, Guinea fowls scavenge for insects, worms, bones, eggshell, leaves and seeds. In Borgou area, vegetables leaves usually consumed are *Cyperus sp*., *Amaranthus sp*., *Andropogon gayanus*, *Brachiaria sp*. or *Rottboelia cochinchinensis*. Since Guinea fowls are mainly granivorous, *Rottboelia cochinchinensis*, *Sida sp., Bracharia sp., Boerrhavia erecta, Panicum sp.* and *Casia occidentalis* seeds are also consumed (Dahouda, 2003). Ayorinde (1990) found that gizzards of Guinea

fowl included, among other things, insects, leaves, seeds and worms. He observed also food variation depending on season, scavenging place, and nature and availability of feed supplements (Dessie and Ogle, 1997; Mwalusanya *et al.*, 2002; McAinsh *et al.*, 2004).

The present study indicated that many farmers offered feed in the morning before scavenging, at midday and sometimes in the evening. Supplementary feed constituting of cereals and their brans - sorghum (30.4%), maize (25.0%), rice (14.3%), maize bran (7.1%), sorghum bran (3.6%), millet (1.8%), kitchen waste (5.4%) or a complete feed (1.8%). According to Bonkoungou (2005) in the Sahelian region of Burkina Faso, sorghum is widely used at 45%, followed by bran and millet respectively in the proportions of 21% and 13%. In Guruve District (Zimbabwe), Saina (2005) reported that only 42% of the Guinea fowl owners provided small amounts of supplementary feed as crushed maize, millet or sorghum grains for keets and whole grains for growers and breeders.

Farmers took special care of keets. Indeed, after hatching, 10.7% of them distributed termites as a source of animal protein. *Figure 1* shows the daily frequency with which supplements were offered to Guinea fowls, i.e., twice a day (37%), three times a day (33%) and sporadically. Distribution time ranged from 06.30h to 08.00h, from 11.00h to 14.00h and from 18.00h to 18.30h. Percentage of farmers who gave supplement twice or trice a day was higher (70%) than those who gave it once a day or sometimes less (30%). A similar survey in Burkina Faso performed on 114 farmers showed that 16% of them distributed supplements once a day, vs trice a day for 54% (Bessin *et al.,* 1998). According to farmers, more feed was available for poultry after harvesting from December to February when grains could be scavenged by birds. Supplementation is sub-optimal and does not meet the bird's nutrient requirements and is used mainly to tame the birds.

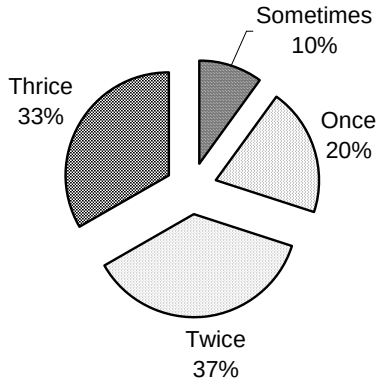

Figure 1 : Number of daily feed supplementation

Most of the farmers (85%) provided drinking water but only in the dry season. This is in line with observations of Bessin *et al.* (1998) and Oumarou (1997) who reported that Guinea fowls drunk water in ponds during the rainy season. In this experiment, the containers were occasionally cleaned (60.0%), never cleaned (3.3%) or cleaned once a day (16.7%), twice a day (3.3%) and three times a day (16.7%) by farmers. Poor water availability and quality may also contribute to reduced Guinea fowls' productivity.

Breeding

Most Guinea fowls started laying between March at the onset of the rainy season and September when the rain stops. Nevertheless, old Guinea hens began laying earlier in January or February. According to Ogwuegbu (1988), egg-laying patterns of the semi-domestiticated, helmeted Guinea fowl are characterized by a peak of egg-laying in July (59%), followed by June (18%) and a minimum in September (0.8%).

No eggs were laid between October and March, i.e., during the dry season. According to farmers, the age at the first lay was between 7 and 9 months. Dahouda (2003) found that under improved conditions, point-of-lay began at 36 weeks with a breeding period of 25 weeks. In Burkina Faso, Hien (2002), studying the effect of prophylactic treatment on laying performance in confined birds, showed that egg production started at 31 to 36 weeks, depending on health. He reported a breeding period of 85 days. The age at point-of-lay observed in this study was in line with 32-36 weeks reported by Ogundipe (1976) in northern Nigeria under scavenging conditions. The breeding season was also similar to that reported by many authors (Ogundipe, 1976; Ayeni, 1980; Oguntona, 1982; Chrysostome, 1995; Laurenson, 2002; Dahouda, 2003). However, Ayorinde and Ayeni (1983) reported 26 weeks. It was also observed in some regions in Nigeria that laying continued all year around in a scavenging systems (Ayorinde and Ayeni, 1986).

The survey also revealed that local hens were used to incubate Guinea fowl eggs and were preferred to Guinea fowl hens. The reasons for such choices by the farmers were reported by Obun (2004) who compared hatching and brooding with Guinea fowl and local hens. The author found that egg hatchability and keet survival were significantly higher ($p<0.05$) with local hens (86.3% and 84.1% respectively) than with Guinea fowl (34.5 and 55.2% respectively). Guinea fowl keepers reported that the incubated eggs came from the farm itself (79.9%) or were purchased from other breeders (20.1%), but rarely from the market. Market eggs are not usually incubated by farmers because of conditions of storage that can reduce egg fertility.

Each hen incubated an average 14±4 eggs. The average incubation time was 26±2 days (n = 74 hens). This value is higher than the 24±2 days reported by Obun (2004). Hatchability increased progressively from March and reached a maximum in June, before falling at the end of lay (October). Hatchability was 72.9% and was higher than the 64% reported by Saina (2005) in Zimbabwe, but lower than the 88% reported by Binali and Kanengoni (1998). Chrysostome (1993) obtained the lowest rate (48%), with eggs from farmers, against 35% when eggs were purchased in the market, confirming the observation that eggs collected from markets are of lower quality. In village areas, Ayeni and Ayanda (1982) obtained values as low as 16.4% during the wet season. Moreover, egg hatchability was lower at the beginning and at the end of the breeding period (*Figure 2*). The peak of hatchability was reached in June and July. A higher fertility and hatchability were also observed in June by Chrysostome (1993). According to Nwagu (1997), the main factors affecting hatchability are egg size, shell quality and variation in brooding temperature. Gordon and Jordan (1982) attributed early embryonic death to maladjustment at a critical period in the development of basic organs caused by jarring or prolonged storage, and to poor hygiene leading to egg infection, e.g. coliform bacteria.

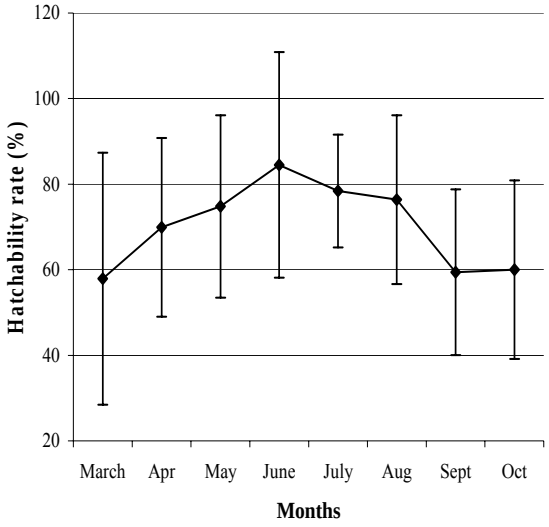

Figure 2 : Monthly hatchability rate of Guinea fowls eggs in Parakou rural area

Average egg weight was 37.7±5 g. The mean value reported by Ogwuegbu *et al*. (1988) for the indigenous Guinea fowls was 34.5 g (range 26.8 to 42.5g). In Burkina Faso, Hien (2002) reported values ranging from 29.1 to 40.1 g. The monthly evolution of egg weight during laying period is shown in *Figure 3*. It shows that egg weight increased from laying onset in February during the dry season to reach a peak in September during the rainy season. Ogwuegbu *et al.* (1988), Hien *et al.* (2002) and Laurenson (2002) also observed that egg weight increasing with Guinea fowl age. Greater natural feed availability in the second part of the rainy season that coincided with the breeding period also contributes to increased egg weight.

From those considerations, it is suggested that the first eggs, which are smaller and give weak keets, should not be used for breeding purpose.

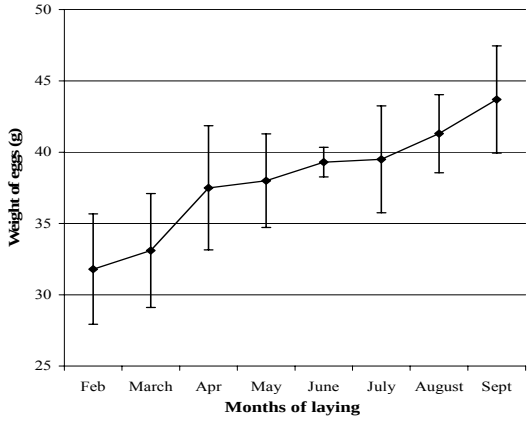

Figure 3 : Average weight of eggs collected in Parakou farms

Guinea fowl growth performance in rural area

Figure 4 shows average body weight of the animals during growing. The average body weight was 25.8±3.2g at hatching and reached 1121±100.2 g at six months. The Guinea fowl is known for its slow growth rate when compared to chickens (Bokoungou, 2005). In Benin, Laurenson (2002) obtained a mean body weight of 1228 g at 7 months of age. It must be noted that in a trial carried out to measure the impact of management system on local Guinea fowl body weight, Dahouda (2003) did not find differences in body weight at six months of age between confined birds receiving a complete feed and scavenging birds. In the free-range systems, keets raised during the rainy season showed even higher mean body weights compared to those raised in confinement during the same period (Savadogo, 1995). In this last case, this could be attributed to beneficial effects of grass, vegetable matter and insects in scavenging groups (Bounkoungou, 2005).

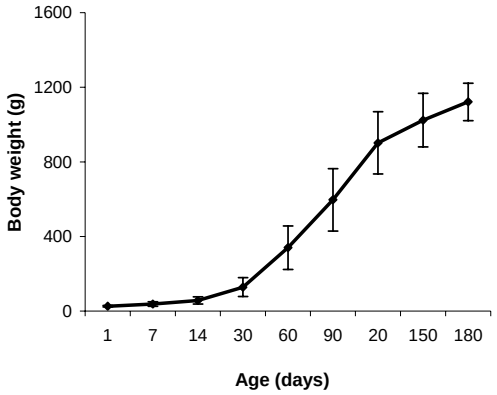

Figure 4 : Average (and SD) weight of guinea fowl until six months

The growth rate was low at 1.7 g/d to 4.7 g/d during the first two weeks. A maximum value of 10.2 g was reached at 4 months and growth rate declined afterwards. Large variability was associated with live weight of the animals (*Figure 4*). This is confirmed by observations made by Mundra *et al.* (1993) who found a high body weight variability at four and eight weeks of age. Boixel (1984) suggested that heterogeneity in body weight was characteristic of Guinea fowl. This might be due to inbreeding observed under scavenging management.

Constraints to rural Guinea fowl production

All farmers reported that losses due to predators constituted a major constraint to Guinea fowl rearing. Predators quoted in decreasing order by farmers included snakes, hawks, shrews, dogs, pigs, ducks, cats and lizards (*Figure 5*). The main predators reported in traditional chicken production in Zimbabwe were birds of prey, wild cats and domestic dogs, but also snakes and rats (McAinsh *et al.,* 2004).

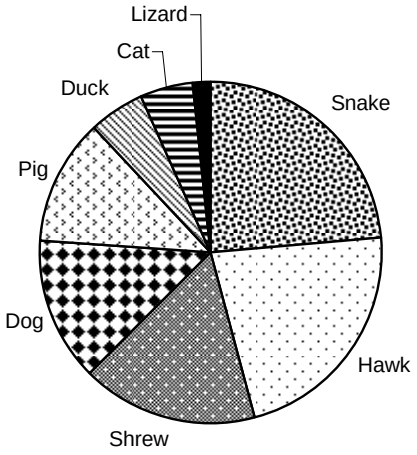

Figure 5 : Keets predators in rural farms of Parakou

Constraints reported by Guinea fowl keepers in the present study included high keet mortality, keet weakness, bad egg quality (especially eggs exposed to bad weather, according to 60% of the keepers), egg losses when layed in brush, loss of keets by predation, poor housing, infestations and intoxications. According to Ayeni and Ayanda (1982), the main constraints to Guinea fowl production in Nigeria included low hatchability, keet mortality, losses of eggs and animals because of scavenging, predator-associated losses, diseases, and food supply, particularly to keets. Elsewhere, a similar survey conducted in the Damongo area of Ghana reported high keet mortality, difficulty in sex determination and lack of a source of quality day-old keets. Other constraints included lack of nutrient requirement guidelines, egg losses during laying, nest changes, poor egg quality for hatching, and loss of keets due to predators or poor housing (Teye and Adam, 2000).

The present survey revealed that keet mortality constituted the major problem and sometimes discouraged farmers; 74% of the interviewees reported that important losses are found in the first month. Most of them are due to exposure to bad weather such as rain, cold or heavy dew, and probably also to parasites. Keets weakness just after hatching was also reported by farmers as a problem, 13% of them estimated this as a serious problem causing mortality. While 4.3% thought that, this was only a small problem contributing to mortality.

Keets mortality from 0 to 6 months ranged from 3 to 100%, with an average of 48±30%. This was lower than the 80% during the rainy season in traditional farms in Burkina Faso by Bessin *et al*. (1998). Ayeni and Ayanda (1982) were in line with our data but during cold season of Harmattan in Nigeria. In Benin, Laurenson (2002) found a global mortality rate of 70.6% ranging from 45.5 to 87.2% depending on farmers management. In a similar survey, Dahouda (2003) recorded a mortality rate of 45±30% in traditional management.
Constraints to Guinea fowl production were multifactorial and frequently related to housing, hygiene and feed supply.

Sales and marketing

Guinea fowls were sold alive. Birds were marketed between 8 and 18 months of age. Sales of birds depended on cash needs and period of the year. Mean animal price in Parakou was 1630 FCFA (2.49 euros) and eggs were sold at 45 FCFA (0.07 euros). Celebrations such as Christmas, New Year, Tabaski, and Ramadan were periods of peak marketing. Transactions occurred either on farm or at market. Belco (1985) observed that in Benin, Guinea fowls and eggs sales were an important farmers' strategy.

Flock composition

The longitudinal survey followed flock composition over 13 months as shown in *Figure 6*. The survey revealed that early in the breeding period (April, May), only adult Guinea fowl (breeders) and keets (0-2 months) were in the flock. Keets numbers dropped from October to March, so no hatching occurred from January to March. Guinea fowls are seasonal breeders, and laying occurs only during the rainy period of the year. The monthly keet population varied largely with the highest proportions of the flocks in June and July while the proportion of growers increased from September 2004 to January 2005. June and July 2004 showed a peak in hatching and the proportion of growers in the flocks was highest from September 2004 to February 2005. Before the next breeding season, some adults (> 6 months) were sold and a few birds were kept for breeding. Farmers reported that large Guinea flocks are difficult to check because of scavenging. When females are numerous, nests are difficult to find when laying start. Thus, important number of animals and eggs are lost.

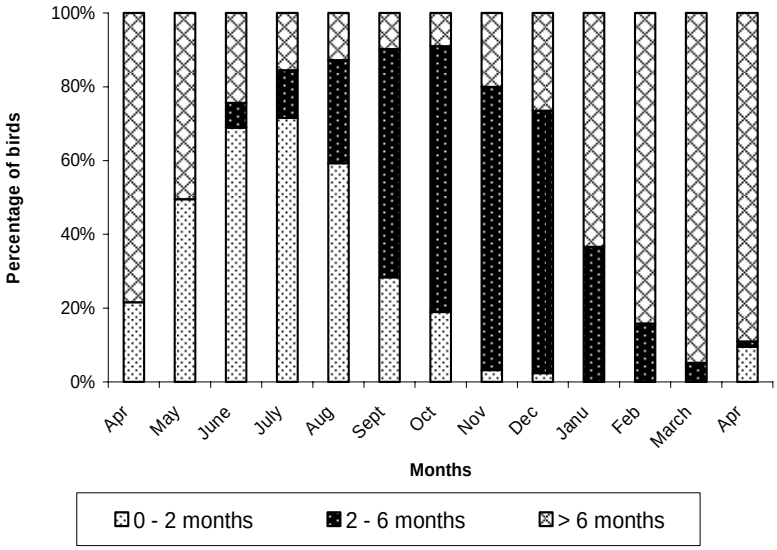

Figure 6: Average percentage and composition of live guinea fowls flock during the 2004 to 2005 breeding season

Conclusions

This study revealed that many factors limit Guinea fowl production under smallholder conditions, including housing, feed supply, keets' mortality, parasites, egg losses and egg quality owing to inadequate storage. Keet mortality from 0 to 3 months was high and constituted the major factor limiting Guinea fowl productivity. Poor food supply is a serious problem in rural areas because supplementation does not cover the animals' nutrient requirements. Poor housing, hygi-

enic and difficult gathering of the chicks at different ages contribute to poor production.

To increase Guinea fowl production in rural areas, it is essential to provide a chicken coop. This constitutes the first protection against predators and inclement weather. The farmer should aim to better manage keets by limiting the scavenging area which is a source of many losses. Regular feed supply has to be provided, particularly to keets that require a high-protein diet in the starting period (during the first 4 weeks). Eggs must be handled with care and diligence to avoid exposing them to sun and rain. Finally, prophylactic and sanitary programs must be considered, focussing on keets to prevent coccidiosis and intestinal parasites.

Acknowledgements

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RESEARCH REPORT No 2:

Indigenous chicken farming in rural conditions of Assam, India

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Summary

Results of the study on performances of indigenous chicken in certain districts of Assam with respect to morphological characteristics, performance traits, incidence of diseases, mortality patterns and health coverage programmes and economies of indigenous chicken rearing were summarized. Indigenous chicken of Assam showed certain variations in regard to morphological features in different districts but not much variation was noticed in between communities of the same district. Egg production performance of indigenous chicken in general was slightly better in Nagaon district compared to Kamrup and Sibsagar districts. Similarly bird reared by tribal communities* performed better than that of non-tribal communities. Most of diseases like Newcastle disease, bacillary white diarrhoea, fowl pox, coccidiosis and fowl cholera were found to occur in all three districts and communities. From economic point of view, profit per bird was found to be higher in Nagaon district than that of Kamrup and Sibsagar. Similarly the profit per bird obtained in non-tribal communities slightly higher than the tribal communities.

Keywords: morphological characteristics; performance traits; diseases; mortality; economy; indigenous chicken; communities; Assam

Introduction

Indian poultry industry as it exists today is a combination of traditional backyard system of poultry keeping and modern space age technology (Vision, 2020). At present, India possesses around 78 million indigenous chickens producing 8.06 billion eggs (Anonymous, 2003). This indicates that India has rich genetic resources (Nallapa *et al*., 2004). Altogether 20 recognized indigenous breeds have been identified so far (Ramappa, 2004) with varied body size, plumage pattern, plumage colour, comb type, etc. The major morphological markers genes creating these variations to increase their adaptability to tropical environment have been well documented (Tomar, 2004).

Assam is the main constituent State of the North Eastern region of India with total area of about 78,438 km^2. About 80% of the total human population of the State lives in villages whose main occupation is Agriculture (Dutta, 2001). Besides, over 90% of the total human populations of the State are non-vegetarian and the people have their traditional

* Groups of people, often of related families, who live together in small villages and without any formal education, sharing the same language, culture and history.

reservation on local poultry egg, meat and fish in their daily dishes (Das, 2003).

In Assam, the total indigenous chicken population is estimated at 12.17 million (Livestock Census of Assam, 2003). Out of it more than 93% are to be found in rural areas (11.40 million). Almost every household keeps a few indigenous chickens to meet its pecuniary needs. Birds are kept in traditional method, which is nearly similar to the free-range system. The systems of bird keeping vary from place to place and community to community. The most popular indigenous fowls of Assam are namely Miri, Daothigir, Frizzle fowl, Naked neck, normal feathered, etc. (Buragohain, 2000; Dutta, 2001; Sapcota *et al.*, 2002).

The present study examines the indigenous chicken farming in rural conditions of Assam with respect to the morphological characteristics, performance traits, incidence of diseases, mortality pattern, health coverage programmes and economy.

Research methodology

Data and information used in the present study were collected on indigenous chickens kept by farmers of different villages in three regions, namely Kamrup, Nagaon and Sibsagar situated in lower, central and upper Brahmaputra valley of Assam through field survey. The study was conducted during the period from July 2005 to May 2006. A farmer who had a minimum of 12 indigenous chickens was considered as an indigenous chicken farmer and average was taken into consideration for each trait of indigenous chicken reared by each farmer for the purpose of the present study. According to flock size in each region, a total of 110 indigenous chicken farmers were randomly selected. Out of them there were 55 tribal and 55 non-tribal indigenous chicken farmers. Thus, a sample size of three hundred and thirty indigenous chicken farmers was taken into consideration. It was practically difficult to collect information about all birds for some traits like body weight of male birds and egg production per laying cycle of indigenous hens reared by farmers of the three regions. In such conditions, lesser farmers were considered for the study.

In order to conduct the present study, morphological characteristics of indigenous chickens were recorded for each sex separately. The body weight was recorded at farmer house at day old, 5 and 10 months of age. The other parameters were noted in the interview scheduled by the investigator with the help of farmers. A total twenty-five eggs and four indigenous cocks and hens were randomly sampled for the study of egg quality and carcass quality traits from each of the tribal and non-tribal community of Kamrup, Nagaon and Sibsagar regions, respectively. The data so collected were compiled and tabulated suitably. The standard statistical methods were used as per Snedecor and Cochran (1994) for analysis of the data.

Results and discussion

Morphological characteristics of indigenous chickens

The morphological characteristics of indigenous chickens in different regions and communities were by and large similar in nature, however certain differences were observed with regard to the type of comb, plumage pattern and plumage colour. Comb type of indigenous chickens was either single or pea. However, few birds with cushion comb were also

seen. Three main types of indigenous chicken were observed during the study, these were normal feathered, naked neck and frizzle feathered. With regard to plumage colour, the majority of birds was parti-coloured followed by black colour and white colour. However few birds with chestnut red, brown, deep chocolate, Columbian, charcoal grey and mottled were also noticed.

Aini (1990) had shown a lot of variations in plumage characteristics of indigenous chickens in different localities of South East Asia. However, Dipeolu *et al*. (1996) reported that the indigenous chickens in South Western Nigeria have features like smooth feathered, solid colour, mottle colour, frizzle feathered, dwarf and naked neck. Similarly Safalaoh (1997) showed that dwarf, naked neck and spotted types were mostly found in the indigenous chickens of Malawi. As reported by several workers (Singh and Johari, 2000; Panda and Praharaj, 2003; Tomar, 2004) feathered comb is a typical character of Faverolla native chicken of Kashmir. Singh *et al*. (2000) reported that feathers are absent in neck region of naked neck chickens and the skin of the neck region is bright red in colour. Ramappa (2004) noted that the tribes and poor farmers in India generally prefer birds with dark plumage for the reason that these birds have better chances of survival against natural enemies.

Management aspects

It was found that farmers usually kept indigenous chickens under backyard or free-range rearing system in which birds were let loose in the morning and returned to the farmers' home yards in the evening. The sheds, in general when provided, are made from local materials such as bamboo, wood, asbestos, thatch, etc. with either inadequate or no litter on floor. It was found that the majority of farmers constructed their houses with bamboo followed by wood, thatch, asbestos and small mud house. It could be noticed that construction cost of poultry shed was found to be higher in tribal communities than the non-tribal ones. This indicates that tribal people might have paid much attention while constructing poultry shed.

Feeding practices

In the present study, birds were usually allowed to scavenge in and around the areas of farmers' houses where birds received the feed in the form of herbaceous seeds, insects, kitchen waste, liquor, grass, herbs, fallen grains, vegetable, fruit waste, etc. It has been observed that some farmers reared more birds than the general villagers. Since the villages are very congested, the birds do not find enough area for scavenging. In such circumstances, some farmers generally prefer to feed the birds with broken rice, rice husk, paddy, rice polish, rice bran, etc., which are purchased from the market at a cost of Rs.[†] 8 to 9 per kg. Some farmers, especially in Kamrup and Sibsagar regions, used synthetic vitamin and mineral supplements.

[†] 1 US$ ≈ 42 Roupies (Rs.)

Performance traits

Body weight

It was noticed that the overall mean body weight of indigenous chicken at day old, 5 and 10 months of age were found to be dissimilar among different regions (*Table 1*). The body weights of indigenous chickens reared by tribal and non-tribal communities were found to be similar at the same age.

Table 1 Body weight (g) at day old, 5 and 10 months of indigenous chickens under different regions and communities.

Sex	Community / Region	Tribal	Non-tribal	Overall
Day old	Kamrup	35.09±0.33	36.18±0.16	35.63[a]±0.24
	Nagaon	34.89±0.23	35.40±0.81	35.14[a]±0.42
	Sibsagar	36.12±0.10	36.27±0.23	36.20[a]±0.16
	Overall	35.36[a]±0.22	35.95[a]±0.20	---
Male (5 months)	Kamrup	862.25±17.31	842.75±14.64	852.50[a]±11.40
	Nagaon	818.62±16.54	798.00±21.31	808.31[a]±13.53
	Sibsagar	809.12±19.04	857.00±20.03	833.06[a]±14.07
	Overall	830.00[a]±10.33	832.58[a]±11.15	---
Female (5 months)	Kamrup	800.70 ± 18.47	782.00±12.77	791.35[a]±15.62
	Nagaon	788.81±13.40	740.00±11.67	764.40[a]±12.53
	Sibsagar	798.36±11.68	780.63±14.70	789.50[a]±13.19
	Overall	796.00[a]±14.51	767.33[a]±13.04	---
Male (10 months)	Kamrup	1389.12±35.30	1361.28±40.66	1375.21[a]±32.10
	Nagaon	1319.75±31.48	1330.20±28.59	1324.97[a]±27.10
	Sibsagar	1339.62±27.49	1345.90±43.14	1342.31[a]±35.31
	Overall	1349.49[a]±24.33	1345.79[a]±39.65	---
Female (10 months)	Kamrup	1081.63±19.09	1017.54±15.36	1049.00[a]±17.22
	Nagaon	1030.63±18.72	1022.36±19.83	1026.50[a]±19.22
	Sibsagar	1012.72±19.05	1062.63±15.88	1037.68[a]±12.36
	Overall	1041.66[a]±18.95	1034.18[a]±17.02	---

Means bearing similar superscripts in a row or column do not differ significantly from each other (P≤0.05).

In general, the body weight of Frizzle fowl and Naked neck was higher than that of common fowl, which might be due to presence of 'FF' and 'Ff' gene in Frizzle fowl and 'Na' gene in Naked neck birds, respectively. It was pointed out by several workers (Singh *et al*., 1994; Singh and Johari, 2000; Sapcota *et al*., 2002; Chatterjee *et al*., 2003; Tomar, 2004) that 'FF', 'Ff' and 'Na' genes are responsible for better heat dissipation mechanism in the body of Frizzle and Naked neck fowl, respectively. This heat dissipation mechanism helped for better adaptability of Frizzle and Naked neck fowl in various adverse conditions than common fowl, which in turn indirectly and positively influenced body weight gain in Frizzle fowl and Naked neck than that of common fowl. Moreover, there were more cocks and hens of Frizzle fowl and Naked neck in Kamrup region followed by Sibsagar and Nagaon. These might be attributed for higher body weight for cocks and hens in Kamrup region than that of Sibsagar and Nagaon regions.

Age at sexual maturity

In the present study, it was found that pullets in Nagaon region matured early than Kamrup and Sibsagar regions. This might be due to the fact that uncontrolled natural breeding might have occurred between indigenous chickens and other improved varieties of chicken in Nagaon region. Moreover, no difference was found between tribal and non-tribal communities from the same region with respect to sexual maturity of indigenous chicken. The age at first egg of indigenous chicken in the present study was within the range observed by Dutta (1996) who showed that the age at sexual maturity of Miri bird in Assam was found to be 164±1.62 days under field conditions while nearly similar age at sexual maturity (162±1.61 days) was observed under cage system of rearing. Contrary to the present observation, several workers (Thomas and Rao, 1988; Ahlawat and Rai, 1992; Ahlawat and Padhi, 2001; Chatterjee *et al*., 2003; Ramappa *et al*., 2004) reported a delayed sexual maturity in indigenous chicken than the present study. Furthermore, they noted that genetic make-up of bird influences the sexual maturity of the bird.

Table 2 Age at sexual maturity (days) of indigenous chickens under different regions and communities.

Region / Community	Kamrup	Nagaon	Sibsagar	Overall
Tribal	168.00±4.52	160.63±4.61	175.63±5.72	168.09^{a}±2.91
Non-tribal	177.27±4.88	161.45±5.28	171.81±4.31	170.18^{a}±3.04
Overall	172.63^{b}±3.73	161.04^{a}±3.57	173.72^{b}±3.73	---

Means bearing different superscripts within a row or column significantly differ from each other (P≤0.05).

Egg production

After attainment of sexual maturity, indigenous chickens laid 11.18±0.48 to 15.49±0.45 eggs in about one month period. Thereafter the indigenous chicken incubates these eggs for a period of 21 days. After hatching, the hen takes care of her chicks for a period of 4 to 6 weeks. This whole process takes around 2.5 to 3 months. The indigenous chicken follows this process about 4 to 5 times in a year. It was noticed that birds of Nagaon region laid more eggs (laying cycle and annual basis) than Kamrup and Sibsagar regions, which is perhaps due to early sexual maturity of indigenous chicken in Nagaon region. Similarly, birds reared by tribal communities laid more eggs (laying cycle and annual basis) than those by non-tribal ones. This is perhaps due to the fact that the tribal people might have taken proper care of hens through feeding and management practices than the non-tribal ones. This finding is in agreement with that of Singh *et al*. (2000). They reported that Aseel hen of Madhya Pradesh produced 10.72, 11.32 and 11.13 eggs under field conditions during first, second and third laying cycle with an overall average egg production of 33.17 eggs per year. Dutta (2001) reported that indigenous chickens of Assam laid an average of 60 to 70 eggs per annum under backyard system of rearing. In contrast to the present finding, several workers (Ahlawat and Rai, 1992; Ahlawat and Padhi, 2001; Ahlawat and Chatterjee, 2002; Chatterjee *et al*., 2003) reported higher annual egg production in indigenous chickens of Andaman and Nicobar Island than the present finding. This egg production differences might be due to genetic make-up of the birds and grading-up programmes.

Table 3 Egg production of indigenous hens under different regions and communities.

Egg production	Community / Region	Tribal	Non-tribal	Overall
Egg number per laying cycle	Kamrup	13.34±0.40	11.18±0.48	12.96^{a}±0.34
	Nagaon	15.49±0.45	13.09±0.42	14.29^{c}±0.38
	Sibsagar	12.56±0.33	14.63±0.40	13.60^{b}±0.30
	Overall	13.80^{b}±0.31	12.96^{a}±0.29	---
Annual production	Kamrup	65.27±2.47	59.90±1.86	62.59^{a}±1.58
	Nagaon	70.09±2.25	63.54±2.52	66.81^{a}±2.50
	Sibsagar	60.54±2.23	64.36±2.35	62.45^{a}±1.78
	Overall	65.30^{a}±1.45	62.60^{a}±1.56	---

Means bearing different superscripts within a row or column significantly differ from each other (P≤0.05).

Hatchability

All indigenous chicken farmers adopted the practice of natural hatching by the use of broody hens. Hatchability rate on total egg set ranged from 81.39±0.78% (Nagaon) to 84.37±0.72% (Kamrup). With regard to communities, hatchability rate was found to be almost similar in nature. In the present study, the hatchability rate in Kamrup region was found to be higher than that of Sibsagar and Nagaon regions. It might be due to the fact that the egg weight of indigenous chickens in Kamrup region was higher than that of Sibsagar and Nagaon regions. Most farmers in Kamrup region set lesser number of eggs under broody hens than in Sibsagar and Nagaon regions. The present finding agrees with the finding of Dutta (2001) who reported more than 80% hatchability rate in indigenous chicken of Assam. However, several workers (Singh *et al*., 2000; Chatterjee *et al*., 2003; Parmar *et al*., 2003) reported a lower hatchability rate in indigenous chickens of Madhya Pradesh, Andaman and Nicobar Island and Madhya Pradesh than the present finding.

Table 4 Hatchability rate of indigenous hen eggs under different regions and communities.

Region / Community	Kamrup	Nagaon	Sibsagar	Overall
Tribal	85.01±0.53	83.00±0.95	82.09±1.15	83.36^{a}±0.54
Non-tribal	83.72±1.31	79.78±1.13	84.18±1.54	82.56^{a}±0.85
Overall	84.37^{a}±0.72	81.39^{a}±0.78	83.13^{a}±1.09	---

Means bearing same superscripts in a row or column do not differ significantly from each other (P≤0.05).

Egg quality traits

External egg quality

Egg weight

The overall mean for egg weight of indigenous chickens has been presented in the *Table 5*. It could be observed that egg weight was lower in Nagaon region followed by Sibsagar and Kamrup regions. This might be due to higher egg production of indigenous chickens in Nagaon region. With regard to communities, egg weight was found to be lower in tribal communities than that of non-tribal communities. This might be due to similar reasons as stated for egg weight

among different regions. In contrast to the present finding, several workers (Dutta *et al*., 1991; Padhi *et al*., 1998; Ramappa *et al*., 2004) reported higher egg weight in indigenous chickens of Assam, Port Blair and Karnataka than the present finding.

Shape index

It was noticed that the shape index value of eggs was higher in Nagaon region than in Sibsagar and Kamrup regions. In general long and narrow egg of any size would have a low index and a short and broad egg (whether large or small) would have a high index. Eggs of indigenous chickens from tribal communities had higher shape index value than non-tribal communities. Similar results were reported by Dutta *et al*. (1991) and Padhi *et al*. (1998) in the eggs of indigenous hens of Assam and Port Blair.

Table 5 Weight and shape index of indigenous hen eggs under different regions and communities.

Trait	Community / Region	Tribal	Non-tribal	Overall
Egg weight (g)	Kamrup	38.56±0.89	40.00±1.20	39.28^{a}±0.75
	Nagaon	36.68±1.23	37.64±0.79	37.16^{a}±0.73
	Sibsagar	38.16±1.20	38.44±1.37	38.30^{a}±0.91
	Overall	37.80^{a}±0.65	38.69^{a}±0.67	---
Shape index	Kamrup	74.37±1.49	71.90±1.62	73.14^{a}±1.11
	Nagaon	74.19±1.67	74.01±1.32	74.10^{a}±1.02
	Sibsagar	74.11±1.47	73.49±1.37	73.80^{a}±0.98
	Overall	74.22^{a}±0.89	73.13^{a}±0.74	---

Means bearing similar superscripts in a row or column do not differ significantly from each other (P≤0.05).

Internal egg quality

Albumen index, yolk index, Haugh unit and shell thickness

The overall mean albumen index value was found to be higher in Kamrup district than in Sibsagar and Nagaon regions. This might be due to the fact that eggs collected from Kamrup region were stored for a minimum period before assessment of albumen index value than the eggs of Sibsagar and Nagaon regions. Moreover, eggs from the non-tribal communities showed higher albumen index than those from tribal communities. In contrast to the present finding, Padhi *et al*. (1998) reported higher albumen index in the egg of indigenous chicken of Port Blair than our present results. This might be attributed to the quality of hen eggs, which might vary according to breeds or strains, rearing temperature, relative humidity and season.

The overall mean yolk index value in Kamrup region was higher followed by those in Sibsagar and Nagaon regions. Yolk index of eggs was found to be higher in tribal communities than in non-tribal ones. In general the size of the yolk present in egg was a factor upon which the yolk index depends. The larger the yolk, the lower is the index. Contrary to the present finding, Padhi *et al*. (1998) reported higher yolk index value in the eggs of indigenous hens in Port Blair.

The overall mean Haugh unit value of egg from the indigenous hens of Kamrup region was found to be higher than that of Nagaon and Sibsagar regions. Similarly, the eggs collected from non-tribal communities showed higher Haugh unit value than from tribal communities. The reason might be due to storage period of the egg, which might have influenced the Haugh unit values among different regions and communities. However, *Dutta et al*. (1991) reported higher Haugh unit value from the eggs of hens of Assam than the present finding.

The overall mean eggshell thickness without membranes was found to be higher in Kamrup region than that of Nagaon and Sibsagar. Similarly, the eggshell thickness without membranes from non-tribal communities was found to be higher than that of tribal communities. This might be due to individual variation in indigenous hens, which influenced the shell thickness. In contrast to the present finding, Dutta *et al*. (1991) reported lower shell thickness in the eggs of indigenous hens of Assam.

Table 6 Albumen index, yolk index, Haugh unit and shell thickness of indigenous hen eggs in different regions and communities.

Traits	Community / Region	Tribal	Non-tribal	Overall
Albumen index	Kamrup	0.082±0.002	0.085±0.001	0.084^{a}±0.001
	Nagaon	0.077±0.002	0.081±0.001	0.079^{a}±0.001
	Sibsagar	0.079±0.002	0.080±0.002	0.080^{a}±0.001
	Overall	0.079^{a}±0.001	0.082^{a}±0.001	---
Yolk index	Kamrup	0.406±0.011	0.386±0.013	0.396^{a}±0.010
	Nagaon	0.381±0.013	0.360±0.011	0.371^{a}±0.010
	Sibsagar	0.401±0.009	0.377±0.011	0.389^{a}±0.008
	Overall	0.396^{a}±0.008	0.374^{a}±0.009	---
Haugh unit	Kamrup	77.72±2.05	78.44±1.37	78.08^{a}±1.25
	Nagaon	72.44±2.26	75.88±2.05	74.16^{a}±1.52
	Sibsagar	74.92±1.66	75.08±2.67	75.00^{a}±1.32
	Overall	75.02^{a}±1.17	76.46^{a}±1.21	---
Shell thickness (mm)	Kamrup	0.293±0.005	0.291±0.006	0.292^{a}±0.004
	Nagaon	0.290±0.004	0.293±0.005	0.291^{a}±0.004
	Sibsagar	0.283±0.006	0.294±0.005	0.289^{a}±0.005
	Overall	0.289^{a}±0.005	0.293^{a}±0.005	---

Means bearing similar superscripts in a row or column do not differ significantly from each other (P≤0.05).

Carcass quality traits

The overall means for slaughter live weight (g), dressing yield (%), giblet yield (%) and ready-to-cook yield (%) for indigenous cocks and hens have been presented in *Tables 7* and *8*.

Indigenous cocks

In the present finding, overall mean slaughter live weight (g) of indigenous chickens was found to be higher in Kamrup region than that in Sibsagar and Nagaon regions. This might be due to the fact that proportionately there were more numbers of frizzle fowl and naked neck fowl in Kamrup region than in Sibsagar and Nagaon regions. Besides, the mean

slaughter live weights of male bird between tribal and non-tribal people were almost similar. Roy *et al*. (2003) also reported similar finding in indigenous chicken of Assam.

The overall mean dressed yield (%), giblet yield (%) and ready-to-cook yield (%) of indigenous chickens were almost similar in different regions and communities. Roy *et al*. (2003) also reported similar findings with regard to dressed yield and ready-to-cook yield. However Sharma (1995) reported lower giblet yield in indigenous chickens of Mizoram under intensive system than in present study.

Table 7 Carcass quality traits of indigenous cocks at 5 months of age in different regions and communities.

Traits	Community / Region	Tribal	Non-tribal	Overall
Slaughter weight (g)	Kamrup	835.00±20.76	815.75±52.60	825.00^{a}±36.68
	Nagaon	785.25±41.16	790.00±47.79	787.62^{a}±31.36
	Sibsagar	802.50±18.36	845.00±27.50	823.75^{a}±20.93
	Overall	807.58^{a}±23.76	816.91^{a}±32.63	---
Dressed yield (%)	Kamrup	66.86±1.28	65.61±1.28	66.23^{a}±0.85
	Nagaon	64.56±1.71	63.89±1.40	64.22^{a}±0.77
	Sibsagar	65.94±1.09	66.49±0.74	66.21^{a}±0.61
	Overall	65.78^{a}±0.73	65.33^{a}±0.68	---
Giblet yield (%)	Kamrup	6.57±0.13	6.44±0.07	6.50^{a}±0.08
	Nagaon	6.35±0.07	6.32±0.11	6.33^{a}±0.06
	Sibsagar	6.50±0.10	6.45±0.10	6.47^{a}±0.07
	Overall	6.47^{a}±0.08	6.40^{a}±0.06	---
Ready-to-cook yield (%)	Kamrup	73.43±1.33	72.05±1.91	72.74^{a}±0.85
	Nagaon	70.91±1.63	70.21±0.59	70.56^{a}±0.77
	Sibsagar	72.44±0.77	72.94±1.00	72.19^{a}±0.61
	Overall	72.26^{a}±0.91	71.20^{a}±0.62	---

Means bearing similar superscripts in a row or column do not differ significantly from each other (P≤0.05).

Indigenous hens

The overall mean slaughter live weight (g), dressed yield (%), giblet yield (%) and ready-to-cook yield (%) of indigenous hens were found to be almost similar in different regions and communities. Roy *et al*. (2003) also reported similar findings in the Miri bird of Assam with regard to slaughter live weight, dressed yield and ready-to-cook yield. However, Sharma (1995) reported lower giblet yield in indigenous chickens of Mizoram in intensive system than in the present study.

Table 8 Carcass quality traits of indigenous hens at 5 months of age in different regions and communities.

Traits	Community / Region	Tribal	Non-tribal	Overall
Slaughter weight (g)	Kamrup	800.00±7.90	755.00±26.92	775.50[a]±11.14
	Nagaon	768.75±17.88	745.00±18.05	756.87[a]±12.76
	Sibsagar	755.10±8.29	787.50±29.18	771.30[a]±15.77
	Overall	774.61[a]±8.08	762.50[a]±12.63	---
Dressed yield (%)	Kamrup	66.56±0.58	65.12±1.02	65.84[a]±0.84
	Nagaon	65.87±1.32	64.09±1.19	64.98[a]±0.69
	Sibsagar	65.54±1.12	66.04±1.34	65.79[a]±1.20
	Overall	65.99[a]±1.34	65.08[a]±0.73	---
Giblet yield (%)	Kamrup	6.15±0.17	6.69±0.14	6.42[a]±0.09
	Nagaon	6.51±0.13	7.11±0.10	6.81[a]±0.10
	Sibsagar	6.99±0.12	6.32±0.18	6.65[a]±0.11
	Overall	6.85[a]±0.08	6.70[a]±0.09	---
Ready-to-cook yield (%)	Kamrup	72.71±1.30	71.81±0.65	72.26[a]±0.72
	Nagaon	72.38±1.26	71.20±1.71	71.79[a]±0.99
	Sibsagar	72.53±1.10	72.36±0.79	72.44[a]±0.63
	Overall	72.54[a]±0.91	71.79[a]±0.79	---

Means bearing similar superscripts in a row or column do not differ significantly from each other (P≤0.05).

Incidence of diseases, mortality pattern and health coverage programmes

The overall mean mortality rate either during growing stage or adult stage of indigenous chickens was found to be higher in Nagaon region in comparison to Kamrup and Sibsagar regions (*Table 9*). The reason for higher mortality rate in Nagaon region might be due to the fact that people of Nagaon region generally did not follow vaccination programme for their birds against most of the diseases. In Kamrup and Sibsagar regions, the mortality rate during growing stage was found to be slightly higher in Sibsagar than that of Kamrup. However the situation seemed to be reverse during adult stage.

With regard to communities, the overall mean mortality percent was found to be higher in indigenous chickens reared by tribal than non-tribal people, which might be due to the fact that tribal people did not vaccinate their birds. Tribal people have habitation usually situated far from the various veterinary hospitals and sub-centers and this might preclude them to have veterinary services for their birds during the outbreak of any disease. In contrast, the situation seemed to be reverse for non-tribal people. Diseases like Newcastle disease, bacillary white diarrhoea, fowl pox, coccidiosis and fowl cholera were found to occur in all districts and communities. However, infectious coryza found to occur in indigenous chickens of Jajora and Islampatti areas only in Nagaon region. The present finding was in agreement with the findings of Aini (1990), Deshmukh *et al*. (1993), Gupta *et al*. (2004) in indigenous chickens of South East Asia, Maharashtra and Meghalaya.

Table 9 Mortality rate during grower period and adult stage of indigenous chickens in different regions and communities.

Stages	Community / Region	Tribal	Non-tribal	Overall
Grower (0 to 20th weeks of age)	Kamrup	33.36±4.54	26.45±4.50	29.90±4.54
	Nagaon	33.27±4.62	38.36±4.65	35.81±4.30
	Sibsagar	35.45±3.77	26.18±3.48	31.22±4.05
	Overall	34.30±3.48	30.33±3.16	---
Adult (21st weeks onward)	Kamrup	24.18±4.05	23.72±4.30	23.45±4.54
	Nagaon	26.09±4.20	27.81±4.61	26.95±4.76
	Sibsagar	25.18±4.41	19.45±4.41	22.31±4.54
	Overall	25.15±4.54	23.66±4.76	---

Causes of mortality: Newcastle disease, bacillary white diarrhoea, fowl pox, infectious coryza, fowl chorea, coccidiosis. Besides, coccidiosis was found to occur only during grower phase of indigenous chickens.

Economy of indigenous chicken farming

The cost of production per bird was calculated to be Rs. 75.91, Rs. 83.16 and Rs. 95.04 in Kamrup, Nagaon and Sibsagar regions, respectively (*Table 10*). The net profit per bird comes out to be Rs. 155.89, Rs. 161.11 and Rs. 136.02 in the respective regions. It was seen that the profit per bird was higher in Nagaon region followed by Kamrup and Sibsagar regions. This might be due to slightly better performance of hens in terms of annual egg production in the Nagaon region followed by Kamrup and Sibsagar regions. Moreover, the cost of production per bird was found to be higher in non-tribal communities than in tribal ones (*Table 11*). Similarly, the net profit per bird was found to be higher in non-tribal communities than in tribal ones, which might be due to higher selling prices of eggs and live birds in non-tribal areas. The main reason for higher selling prices of eggs and live birds was the proximity of their location with urban or semi-urban areas. These findings were in agreement with those reported in Bay Island (Rai *et al*., 2000) and in Bankura district of West Bengal State (Mandal *et al*., 2003).

Table 10 Cost of production of indigenous chickens (Rs./bird) from 0-72nd weeks of age in different regions.

Items		Kamrup	Nagaon	Sibsagar
A)	Non-recurring expenditure			
	1. Land	Existing	Existing	Existing
	2. Construction of poultry shed	51.24	54.62	48.85
	3. Equipment (approx.)	3	3	3
B)	Total non-recurring expenditure	54.24	57.62	51.85
C)	Recurring Expenditure			
	1. Cost of chick	5.90	6.75	6.40
	2. Cost of feed	36.95	45.16	53.37
	3. Cost of medicine and vaccine	4.25	-	6.90
	4. Miscellaneous expenditure (approx.)	2	2	2
D)	Cost of production of a live bird	49.10	53.91	68.67
E)	Depreciation			
	1. Poultry shed	26.36	28.80	25.92
	2. Equipment	0.45	0.45	0.45
F)	Total depreciation	26.81	29.25	26.37
	Actual production cost of a live bird	75.91	83.16	95.04
G)	Income			
	1. Sale of egg	132.65	141.57	132.94
	2. Sale of live bird	99.15	102.70	98.12
H)	Total Income	231.80	244.27	231.06
I)	Net Profit	155.89	161.11	136.02

Table 11 Cost of production of indigenous chickens (Rs./bird) from 0-72nd weeks of age in different communities.

Items		Tribal	Non-tribal
A)	Non-recurring expenditure		
	1. Land	Existing	Existing
	2. Construction of poultry shed	56.25	46.88
	3. Equipment (approx.)	3	3
B)	Total non-recurring expenditure	59.25	49.88
C)	Recurring Expenditure		
	1. Cost of chick	5.66	7.03
	2. Cost of feed	41.06	49.27
	3. Cost of medicine and vaccine	-	5.57
	4. Miscellaneous expenditure (approx)	2	2
D)	Cost of production of a live bird	48.72	63.87
E)	Depreciation		
	1. Poultry shed	29.12	24.93
	2. Equipment	0.45	0.45
F)	Total depreciation	29.57	25.38
	Actual production cost of a live bird	78.29	89.25
G)	Income		
	1. Sale of egg	130.60	140.85
	2. Sale of live bird	95.19	104.81
H)	Total Income	225.79	245.61
I)	Net Profit	147.50	156.41

Conclusion

Rural upliftment and nutritional standards can be accomplished through indigenous chicken farming which can adapt to harsh environment with a very little care on feeding and management. However, to improve the production potential of these birds, due attention towards upgrading, balanced nutrition, better management and proper health care is to be given.

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Contribution of poultry production to household income: a case of Jos South Local Government in Nigeria

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Summary

A survey was carried out between April and July, 2005 in four randomly selected villages of Jos South Local Government, Nigeria, with the aim of studying the dynamics of household poultry production and its contribution to household incomes. The study revealed that household poultry rearing contributes significantly to standard of living of the resource-poor individuals in peri-urban areas of developing countries like Nigeria. Causes of setbacks in production were highlighted and suggestion offered to boost this area of agricultural production.

Keywords: chicken; household poultry production; Nigeria; poverty

Introduction

Poultry are the most numerous farm animals throughout the world, and the situation is similar in Nigeria (Bourn *et al*., 1992). Although the importance of poultry contribution in terms of income and protein supply varies widely from the developed to the developing economies (Smith, 1992; FAOSTAT, 2006, Permin and Hansen, 1998), it is enormous in the developing countries where a larger percentage of the human populations are basically rural and agrarian. In recent times, poultry production as a socio-economic activity is moving from a mere subsistence form of agriculture to taking a more commercial oriented approach especially in the developing economies (FAOSTAT, 2006).

In Nigeria, poultry production enjoyed a boom in the early 1980s due to the government subsidies on day-old chicks and feed. This was followed by a downward trend in the industry due to subsidies removal but in recent times, the industry is again experiencing growth due to the current regime's effort at encouraging the citizenry to invest in the industry, several economic and agricultural policies reforms and removal of import duties on agricultural products.

Socio-economic research findings indicated that the Nigeria poultry meat production assumed tremendous growth in the last few years. It transformed from 0.08 million tons in 2001 to 0.11 million tons in 2004, while its percentage contribution to livestock GDP moved from 4.29 to 4.45 % in 2001 and 2004 respectively (Central Bank of Nigeria Report, 2004).

Family/household poultry represents approximately 94% of total poultry keeping; and 83% of the estimated 82 million adult chickens in Nigeria as of 1992 (Sonaiya and Swan, 2004). It is characterized by small to medium numbers of local and sometimes exotic breeds with non-salaried labour for the purpose of income generation, food security and gainful employment especially for women and children. However, the full potentials of household poultry production have not been fully harnessed (Maho *et al*., 2000; Sonaiya and Swan, 2004). Family poultry particularly in the peri-urban areas is also moving from the keeping of few birds mainly on free range as described by previous workers (Sonaiya and Swan, 2004) to keeping hundred to a few thousand commercial birds to achieve the purposes stated above.

In this study, we evaluated the importance of contribution of poultry in a metamorphosing (transforming from rural to urban) society of Jos South Local Government and presented our findings.

Materials and Methods

Study area

Jos South Local Government with a human population of 311,371 (Nigerian Government, 1991 Census) is an administrative area in Plateau State, Nigeria located in the latitude $9^0$40'44"N and longitude $8^0$50'02"E. It has a sub-tropical climate with temperature ranges of 21-24^{0}C, a plateau grassland and represented the highest peak in Nigeria with altitude of about 1000m (3281ft) above sea level. The average annual rainfall of the study area is 1400-1800mm/annum and the mean relative humidity varies between 14-74%. Four (4) of the major communities (Vwang, Kuru, Gyel and Du) within the local government were randomly selected, and a further stratified random selection of farms was made in each community.

A total of forty (40) farms were selected and the farmers were administered a set of structured, pre-tested and evaluated questionnaires. The study was carried out between April and July 2005.

The responses were analysed using descriptive statistics

Results

The response rate to the questionnaires was 92.5% (37) comprising farmers from the four (4) communities. The sampled population was 62% male and 38% female, with age ranging from 21-30 years (30%), 31-40 years (43%) and 41-50 years (27%). 62.2% of the respondents are married and a majority (73.8%) have up to tertiary education with an average family size of six (6). There were 54.1% full-time farmers, and 45.9% were part time with the farm size (number of birds) ranging between 1-500 (64.8%), 501-1000 (21.6%), 1500-2000 (8.1%), 2001-2500 (5.4%) and 2501-3000 (2.7%).

Years of poultry operations range from 1-25 years (*Figure 1*). The respondents predominantly sell their products to marketers (73%) as against directly to consumers (27%). This was further confirmed by the utilization of poultry products (*Figure 2*). The percentage of contribution of different sources of income indicated a heavy reliance on poultry (*Figure 3*). The responses also indicated that majority of the farmers does not keep records (89.2%) and were not able to distinguish between major poultry diseases except for Newcastle disease and coccidiosis. Most respondents are not willing to abandon the poultry business.

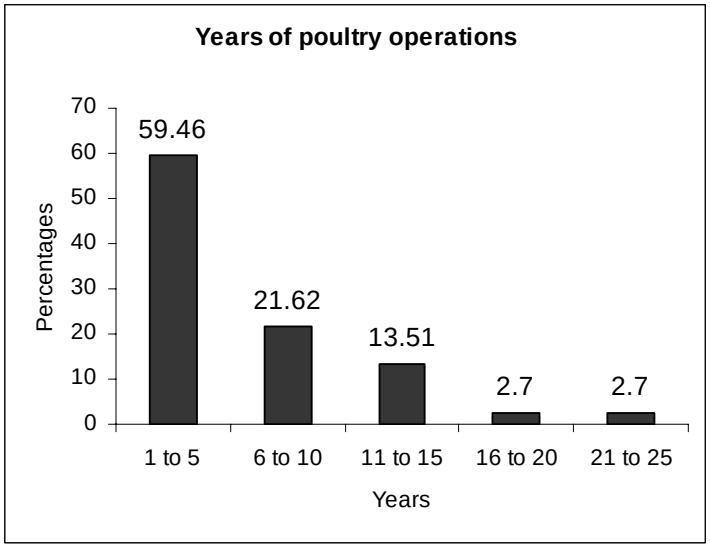

Figure 1 Years of activity in poultry operations.

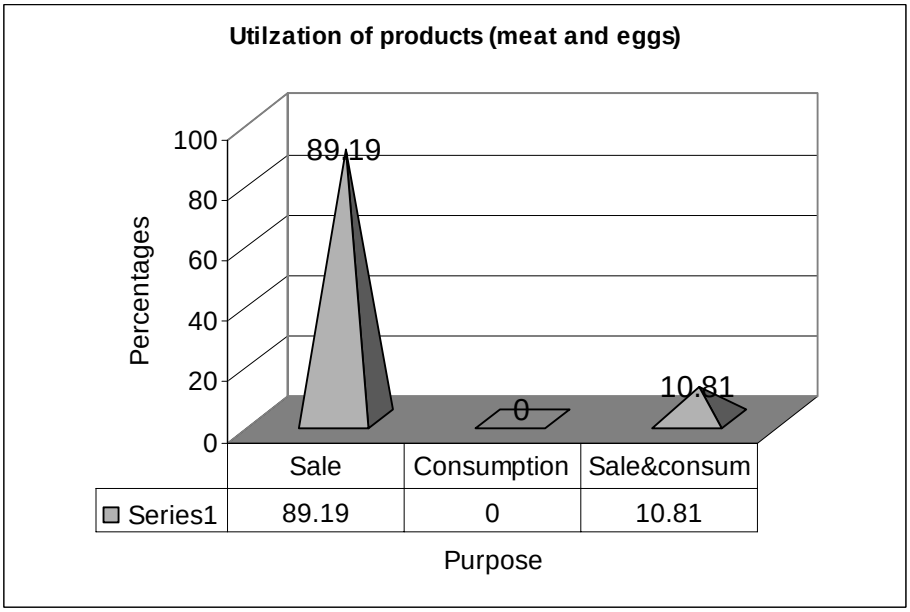

Figure 2 Utilization of poultry products.

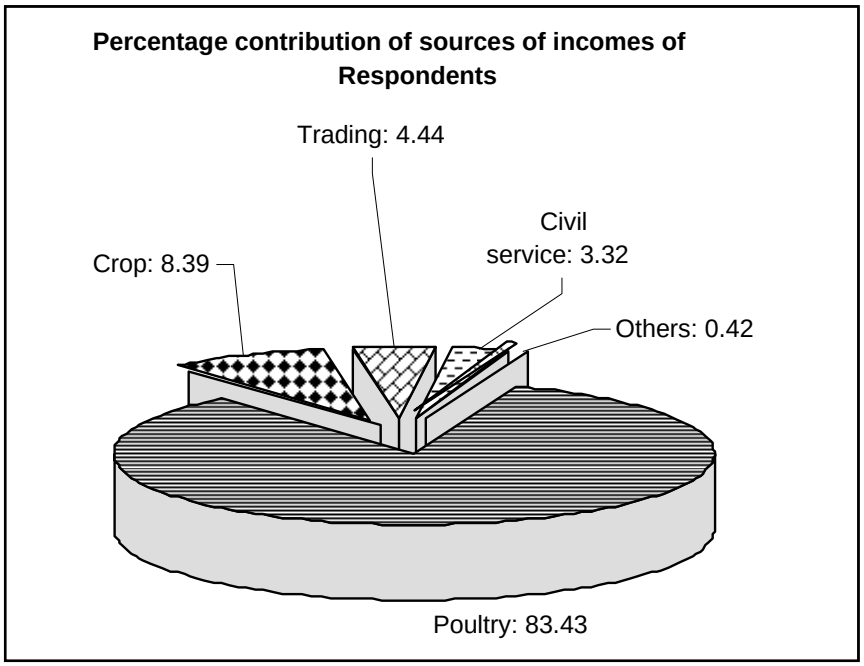

Figure 3 Percentage contributions of sources of income of surveyed farmers.

Discussion and conclusions

Previous studies had indicated that agricultural industry employs about 60% of the workforce (Nigerian Government, 2006, Obadina, 1999). Our findings are positively correlated to the assertions above since 100% of the respondents fell within the working class group considering the age factors and only 45.9% of these were gainfully employed. Thus, the contribution of poultry production as a major source of employment at household level can not be underestimated. Dolberg (2001) indicated that poultry is the basic livestock with which the extremely poor begin to climb the ladder of asset accumulation. Our results similarly showed that there are significant increases in number of birds kept by farm families by comparing their initial stocks to the numbers during the study period, and findings revealed that families with larger poultry size also keep larger stock, a factor indicative of positive development and more incomes for the families. Poultry can therefore be said to be a venture that can start very small and contribute significantly to family incomes. Around 73% of all surveyed farmers sell their products directly to marketers, and a further 89.2% cited sale as the only reason why they keep poultry; this strongly emphasised the fact that poultry is a poverty alleviation tool of commercial value. This is in accordance with previous work citing income generation as the primary goals of poultry keeping (Sonaiya and Swan, 2004).

The majority of the respondents (81%) have spent less than 10 years in poultry operations, a finding that was directly correlated to the period when there are sectoral reforms (economic and agricultural), relative increasing level of unemployment and more encouragement in agricultural production. Though most of the respondents (54.1%) were full-time farmers, poultry alone contribute over 83% of the incomes of the sampled families proving that poultry is a major economic activity for the various families. This agreed with the work of Sonaiya and Swan (2004). The work therefore concluded that poultry contribute significantly to enhanced livelihoods in households of a transiting society like Jos South Local Government area in Nigeria. Similarly, the increasing demand for poultry (Mack *et al*., 2005), the increas-

ing urbanization in the developing nations (Winrock, 1992) and the wide acceptability of poultry meat therefore made it necessary to enhance the development of poultry production at household level.

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Role and relevance of rural family poultry in developing countries with special reference to India

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Summary

Livestock plays a pivotal role in the livelihoods of rural masses in the developing countries. Worldwide, more than a billion people currently live in extreme poverty especially in developing countries of Afro-Asian region. Hunger and malnutrition continue to be serous problems, even in countries with a surplus food production like India. On a global level the problem is not of lack of food but access to food due to very low purchasing power of poor people. The challenge of fighting poverty and malnutrition can be effectively met to a large extent by strengthening traditional family poultry production, which plays a major role in the rural economy of Afro-Asian and Latin American countries as it accounts for about 80% of the world's poultry production and up to 90% in least developed nations. Family poultry provides cash income, utilizes spare family time and contributes significantly to nutritional security of weaker and vulnerable sections (women and children) of rural masses. Many developing nations including India have made spectacular achievements in the area of poultry production during the last three decades but this has not improved the availability of poultry products and purchasing power of rural masses in the countryside of India. The availability of eggs and poultry meat is very low i.e. 44 eggs and 1.7 kg meat per year against the recommended level of 180 eggs and 11 kg meat as compared to 120 eggs of world average and 250 eggs in developed countries. Population growth, urbanization and successive years of drought have further led to increased reliance on such traditional low risk production activities in poor countries. The main activities to improve scavenging poultry holdings have been the introduction of cockerels and some crosses. However, the effect has been rather small because they have not been followed by other improved management interventions. In Bangladesh there has, during the past decade, been developed a most successful model for semi-scavenging family poultry. Similar efforts are needed in other developing countries with the active participation of all stakeholders to strengthen and promote family poultry, which can be a very effective tool for fighting the abject poverty, and providing nutritional security and livelihoods.

Keywords: family poultry; poultry production; poverty; malnutrition; nutritional security

Introduction

Worldwide, more than a billion people currently live in extreme poverty especially in developing countries of Afro-Asian region. Poverty is one of the main causes of food insecurity and civil conflict; it also poses as a barrier for the achievement of sustainable economic and social development. It is characterized by large inequalities in wealth distri-

bution between rural and urban areas, which restricts the growth of domestic markets and contributes to the stagnation of agriculture. India alone is home to some 350 million poors, which is about 30% of world. Hunger and malnutrition continue to be serous problems, even in countries with a surplus food production like India. On a global level the problem is not of lack of food but access to food due to very low purchasing power of poor people. As per the last FAO report on The State of Food Insecurity in the World (SOFI 2002), about 840 million people are undernourished, out of which 799 millions live in the developing world (95%), particularly in Asia (507 millions - 60%). However, the prevalence of undernourishment in Asia is moderate (16% of the region's population) as compared with the severe levels in Central, East and Southern Africa. In fact almost half (45 %) of the 371 million people living in the 26 countries of these African sub-regions are undernourished. In India about 40% children are suffering from malnutrition. According to Dr. M. S. Swaminathan "the father of green revolution of India, the country has achieved cereal security but nutritional security is yet to be achieved. If the current rate of hunger reduction of 2.5 million persons per year in the developing world were to continue, the target of reducing the number of undernourished by half by 2015 would be reached more than 100 years late". This paper addresses some of the challenges in combating poverty, malnutrition and providing support for sustainable livelihoods to rural poor.

One of the major challenges facing FAO Member Nations today is food security, especially in Low-Income Food-Deficit Countries (LIFDCs). Though increases in agricultural productivity at the country level have led to improvement in the livelihoods and food security conditions of many urban consumers, they improved the livelihoods of rural producers to a much lesser extent. This situation is due to several factors, including internal urban policy biases against agricultural profitability, declining international terms of trade as a result of protectionist policies, and a general lack of understanding of the role of rural small-scale livelihoods.

Civilization of mankind started with the domestication of livestock. The developing countries of Afro-Asian region are characterized by a wide variety of topography, agro-ecology, climates, cultures and production systems. Livestock plays a pivotal role in the livelihoods of rural masses in the developing countries. Poultry production systems of the developing nations of African, Latin American and Asian countries, including India, can be broadly categorized into two distinct classes: one – extensive, low external input rural family poultry production system or free-range or backyard poultry in unorganized sector in the villages and the other one is high input industrial or intensive poultry production system in urban and peri-urban areas. The former is highly unorganized and consists of thousands of small holders (5-15 birds) where birds scavenge and forage on house-hold wastes, shrubs, weeds, crop residues, insects and aquatic plants with no or little external inputs. The birds are looked after by the families specially women and children. The locally adapted indigenous chicken germplasm thriving well under stressful and low input production system in the countryside may appear to have low productivity in comparison to highly specialized industrial germplasm but it is highly efficient converter of available low quality feed and other resources which otherwise are likely to go wasted. Native birds are hardy and resistant to most of the diseases/parasites.

What has been done?

Poultry in India was a backyard village venture till 1960. The entire poultry scenario of the Indian sub-continent changed only in last 3-4 decades and now India ranks 4th in egg production and 5th in broiler production with about 42,000 metric tons (MT) and 1000 million eggs and broilers produced annually. But in terms of per capita availability it

ranks amongst the lowest. Though, the number of native birds has increased marginally from 63 million in 1961 to 78 million in 2000, they are being indiscriminately replaced very fast by exotic birds but their contribution in providing supplemental income and nutritional security to poor and landless households is significant. The percentage of native poultry population has declined very rapidly from 94.2% in 1961 to 8% in 2000. The average egg production of native birds in India is less than half of native birds of other countries as it has reduced from 60-70 eggs in 1960 to 40-50 eggs in 2000 (Sharma, 2000; Sharma *et al.,* 2004). It is roughly estimated that 10 native hens can provide the same income as a woman earns from a day's work and can stay at home and take care of children and other household activities without affecting family income (Banerjee and Sharma, 1998).

Poultry industry of India is providing employment to about 3 million people and contributing over Rs.[‡] 290 billion (about 1%) to the country's GNP. Every additional egg and 50 g of broiler meat production means 25,000 and 20,000 more jobs. Moreover to create one job there is need of Rs.50, 000 and Rs.75,000 in egg and broiler segment whereas it requires Rs.5,000,000 to create one job in engineering industry (Sharma, 2000). Poultry is the least cost alternative only next to fish. In terms of conversion of feed into high-quality animal protein, broilers rank first followed by layers, goat, pig, beef and milk. Poultry produces white meat and contributes about 25% of the total meat produced in the world. It requires less capital, has wider acceptability and gives quick returns and hence more crop turn outs per unit of time. Private sector is playing a significant role by supplying about 95% of demand of day-old chicks of commercial layers and broilers. All the world's leading brands (10-12) of layers and broilers are available in India through a network of franchise hatcheries.

The challenge of fighting poverty and malnutrition can be effectively met to a large extent by strengthening traditional family poultry, which plays a major role in the rural economy of Afro-Asian and Latin American countries as it accounts for about 80% of the world's poultry production and up to 90% in least developed nations. Unfortunately no attention has been paid in the past to promote and strengthen the rural poultry; and, as a result of this, most of the valuable poultry germplasm has either been lost or has been degraded. Had the animal protein needs of India not been met to a large extent by the growth in broiler production, mutton would have been selling now at Rs. 500 and chicken, which is now considered the poor man's meat, would have become a luxury. The per capita availability of pulses has come down severely from 61 g in 1961 to less than 38 g which is causing malnutrition and protein deficiency. Many developing nations, including India, have made spectacular achievements in the area of poultry production during the last three decades; but this has not improved the availability of poultry products and purchasing power of rural masses in the countryside of India. The availability of eggs and poultry meat is very low i.e. 44 eggs and 1.7 kg meat per year against the recommended level of 180 eggs and 11 kg meat as compared to 120 eggs of world average and 250 eggs in developed countries. Moreover, there is a vast gap for the per capita availability of eggs in rural and urban India (6 vs. 185 eggs), which needs to be bridged to improve the nutritional status of rural masses. In rural areas the poultry products still continue to cost almost double the price of urban areas since most of the commercial poultry ventures are located in urban and peri-urban areas (Sharma, 2000). About 25% people living in urban areas consume about 75% of eggs and 100% broilers produced in India. Population growth, urbanization and successive years of drought have further led to increased reliance on such traditional low risk production activities in poor countries. The main activities to improve scavenging poultry holdings have been the introduction of cockerels and some crosses. However, the effect has been rather small because they have not been followed by other improved management interventions.

[‡] 1 US$ ≈ 42 Roupies (Rs.)

Chickens produced from family poultry are stress and residue free and are as good as organically produced. Family poultry is environment friendly; it does not compete for cereals and other grains with humans and for cakes with other species of livestock. Intensive poultry are proving to be major environmental hazard in developed countries due to excessive excretion of phosphorus and other unitized nutrients in the faeces, which are causing soil sickness. Moreover, waste disposal, nuisance of flies and rodents and emissions of ammonia are severe associated problems with industrial poultry. Family poultry can address gender issues by empowering rural women in developing countries. Family poultry plays a vital role in supplementing rural communities with income in addition to providing animal protein/ nutritional security to rural masses specially the vulnerable section (children and destitute women). It has been found that chicken eggs produced by native birds have better egg shell quality in terms of both egg shell thickness as well as egg shell weight and hence are better suited for longer storage period and transport under village conditions. The elite birds of the stock can be utilized to improve eggshell quality of industrial chickens through appropriate gene transfer.

The researchers over the world have begun to utilize/conserve their native animal genetic resources to develop stocks that are suitable to their own agro-ecological conditions and production systems. FAO (1999) has also recommended continued use, development and conservation of such germplasms in developing countries for long term sustainable exploitation of these extensive and family-based poultry production systems. Bangladesh has successfully developed a model called as "Small Farming Poultry Development Model" which is popularly known as the 'Bangladesh Model' for improving productivity of native chickens through the supply of birds with improved productivity, supplementation of scavenging with feed, training of villagers, cheaper credit from local rural banks and involvement of NGOs and SHGs (Sharma *et al.,* 2001). The experiments in Bangladesh have shown that improved breeds are superior to local/native hens under field conditions. A crossbreed between RIR and Fayoumi was found superior to the purebreds under semi-scavenging conditions. China has successfully retained most of its indigenous poultry germplasm and has been able to considerably improve its productivity by two fold from a meager production of 60 eggs to 120 eggs a year (Sharma *et al.,* 2004). China is also one of the largest producers of chicken eggs and meat in the world with its 80% contribution coming from family poultry.

Since all the 18 indigenous chicken breeds of India are facing extinction due to indiscriminate replacements through exotic chickens, their numbers need to be increased and productivity level raised by selective breeding for egg production, egg weight, growth rate especially in important and unique/popular breeds like Aseel, Kadaknath, Naked Neck, Gaghus, Miri and Kashmiri (Sharma *et al.,* 2004). Therefore, there is a need to evolve appropriate strategies for improving productivity of family poultry under small holdings in the unorganised sector through the introduction of chicken germplasm with improved productive-adaptability, supplementary feeding, improved shelters and utilization of untapped locally available feeds and other resources. The low producing non-descript local chicken germplasms can be improved by crossbreeding with RIR and WLH breeds. The optimum inheritance level can be found out by carrying out research work for various production systems. Similar efforts of improving indigenous chicken germplasm should be initiated at all Veterinary and Agricultural Universities/Institutions of India using appropriate breeding strategies so that per capita egg and poultry meat availability rises from a meager 44 eggs and 1.7 kg meat to the recommended level of 180 eggs and 11 kg meat. The preliminary work carried out by the author suggests that it is possible to increase the existing profitability of family poultry by 2 to 3 folds from Rs. 150-200 to Rs. 300-400 per bird by rearing the improved stock developed under the rural and improved backyard systems, respectively (Banerjee and Sharma, 1998; Sharma *et. al.,* 1999) through the use of improved germplasm and supplementing scavenging. The study also revealed that crosses

of indigenous chickens with WLH, RIR and Australorp have better growth rate and lower age at sexual maturity with no difference in viability compared to native chickens. These crosses produced 208, 189 and 172 eggs under improved management conditions as against 153, 138 and 134 eggs under backyard system in that order in comparison to 90 and 70 eggs laid by indigenous birds under the two systems, respectively. It was also found that improved native chickens have higher acceptability and saleability among local people with no difference in viability as compared to native genotypes (Sharma *et al.,* 2004).

What can be done?

Efforts are on the way in some other countries like Malawi, Morocco, Uganda, Mozambique, Burkina Faso, Cuba and Benin with the assistance provided by International development agencies like The Department for International Development (DFID), UK and the International Network for Family Poultry Development (INFPD) of FAO. DFID is undertaking a very large mission partnership initiative in the State of Andhra Pradesh (India) in primary education, employment generation, poverty eradication, and water conservation under watershed scheme with a component on family poultry. Every country has its unique features and the same successful model may not fit well in other countries hence it is essential to develop an appropriate model of our own to suit our requirements. However, it may be used as a guide and can be used with some modifications.

There is tremendous potential for improving rural poultry through smallholder units if the genetic and non-genetic components of poultry are taken care of. Therefore, it is immaterial to look which bird produces more eggs or meat but at what cost? Keeping in view the above facts, it is necessary to promote and strengthen the family poultry production system, which is already ecologically sustainable and economically viable by introducing improved and suitable poultry germplasm along with appropriate management practices so that it can augment the rural economy through enhanced profitability. Moreover, it will ensure nutritional security thanks to the ready availability of poultry products at affordable prices in rural areas. It will also provide additional income and employment to the rural poor and will arrest migration of rural populace to already overpopulated cities. Promotion of family poultry will also halt erosion of remaining bio-diversity of the gene pool of the poultry.

Major constraints of family poultry are: non-availability of appropriate germplasm, high incidence of early mortality, lack of paravet facilities, and lack of knowledge regarding hygiene and shelters. The stock should be hardy and reasonably productive and should not require special attention. Family poultry suffers from the lack of viable technology, and suitable marketing and transport infrastructure. It also suffers from the lack of research and development efforts to diversify poultry production by using other species like Guinea fowls, ducks, quails, etc. India has an impressive population of 300 million middle classes living in towns and small cities, which are best customers of meat of native chickens. Alternatively, it can be sold at a premium to elite class in big cites.

Conclusion

Domestic animals contribute to the livelihoods of more than two-thirds of the world's rural poor. For poor farmers, the loss of one or two cows can mean no milk to drink and no money for medicines or children's education. There is growing consensus that sustainable rural development and reduction in rural poverty can not be achieved just by increasing

financial flows to the rural sector. The self-help capacities of rural people, and especially the poor, have to be strengthened so that they can become more active partners in the development process, through the use of more participatory, multi-sector and multi-stakeholder approaches to agricultural policy making and implementation.

Producing eggs and meat for the growing population without further degrading the environment is the greatest challenge mankind ever faced which can be met only by improving productivity of the family poultry production system. The productivity of industrial bird is nearing plateau and will require more efforts and money for per unit of improvement and is also more likely to degrade the environment further. However, industrial poultry can complement family poultry and can continue to contribute in areas of affluence.

There exists tremendous scope to promote and strengthen both industrial and family poultry production system as lot of infrastructure has already been created to support the further development of poultry. Poultry has the potential to employ more than 9 million people and can contribute Rs. 900 billion to GNP in India. Family poultry can, therefore, be very effective instrument for fighting abject poverty, providing nutritional security and livelihoods.

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Village chicken health, management and production indices in selected villages of Borno State, Nigeria

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Summary

The health, management and production indices of village chickens in Nigeria's Borno State were studied using standard questionnaires and hemagglutination inhibition test for the detection of active and passive Newcastle disease virus (NDV) antibodies. Village chickens were found to constitute 62% of the total livestock population in the areas studied. The average number of chickens per household was 23, and the average number of eggs laid per hen per clutch was 13 with 81.5% hatchability and 26.1% survival rate to adulthood. Village chicken production was observed to be an overall family affair with the women dominating the ownership and management responsibilities. The farmers raise these birds to earn cash income, for food, breeding, etc. Housing for village chickens, where provided, was for night shelter only and is made up of mud walls and thatched roofs; or else the birds roost on tree branches, roofs, kitchen, uncompleted buildings, etc. Birds scavenge for their feeds with the farmer supplementing very little with grains. Diseases constitute the highest cause of losses (59.9%) in the village chicken production followed by predators (23.2%) and ectoparasites (16.8%). The incidence of these diseases is highest during the cold Harmattan season. The seroprevalence of Newcastle disease (ND) among this group of birds was 46% and no statistical difference ($P>0.05$) was noted with the geometric mean titre (GMT) of HI antibodies between the sera (active) and egg yolk extract (passive).

Keywords: village chicken; Newcastle disease; management; production indices; Borno State; Nigeria

Introduction

Village poultry production is the livestock enterprise available to all farming families, even the poorest ones (Bell, 1992). These consist of the edible domestic birds that include chickens, ducks, Guinea fowls, geese, pigeons, turkeys, ostriches, quails, pheasants, etc. (Njue *et al*., 2002). Of all these, chickens are the only species that are widely accepted by people from a vast variety of cultural and religious backgrounds (Ideris *et al*., 1990). Village chickens comprise the major part of the poultry industry in developing countries (Spradbrow, 1997). In Nigeria, there are about 85 million chickens with 89% of them raised on free range (Bourne *et al*., 1993). Rearing of village chickens is popular in rural areas and serves as a means of providing supplementary food, in form of animal protein, and as savings in order to respond to emergencies and prime necessities (Bagnol, 2001). They have diverse genetic resources and survive under various weather conditions sheltered or otherwise (Nel, 1996; Alders and Spradbrow, 2001), but still provide meat with

pleasant flavour and low fat content, which is preferred taste by the society (Guèye, 1998). A village hen is capable of producing 13kg of meat per annum (Sonaiya *et al*., 2002). They are referred to as low input / low output system of poultry farming (Sayila, 1999). Village chickens depend mainly on scavenging for feed by themselves with little or no feed supplementation by the farmers (Moreki and Masupu, 2001). Diseases have been identified as one of the major constraints to successful village chicken production because of the greater relative proportion of infectious agents due to low hygiene and special climatic conditions and the lack of vaccination (Jagne *et al*., 1991). Therefore the aim of this study was to study the management and productivity of village chickens and the seroprevalence of Newcastle disease in selected villages of Borno State, Nigeria.

Materials and methods

Study area

This study was conducted in five selected villages of Borno State, Nigeria. Borno State has an estimated area of 70,898 km^2 and a population of 2,596,589 (Anonymous, 1995). The State is located in the extreme north-eastern corner of Nigeria and shares international borders with the Republics of Cameroon, Chad and Niger, and national borders with Adamawa, Gombe and Yobe States. Majority of the inhabitants of Borno State are farmers, animal rearers or fishermen. The study was carried out in two local government areas of Askira/Uba and Mafa. Askira/Uba is located in the southern part of the State and has an annual rainfall of 650-1100 mm that starts in April and ends in November. Mafa, on the other hand is located in the North-eastern part of the State and has an annual rainfall of 600 mm that starts in June and ends in September.

Study design

The data on management, productivity and health status of the village chickens in Borno State were collected from 3 villages in Askira/Uba and 2 villages in Mafa local governments using a standard questionnaire as prepared by Alders and Spradbrow (2001). Five farmers were selected from each village, on the advice of the village extension worker or the community development officer, in collaboration with the village head, taking into consideration poultry farming practices and previous cooperation of the farmers in similar previous exercise.

Seroprevalence study

A total number of 200 serum samples were collected from the village chickens in the selected villages. Blood was collected from the wing vein of each bird using sterile syringe and needle and transferred into sterile vacutainer tube. The blood was allowed to clot at room temperature, and the sera were separated using manual centrifuge and transported to the laboratory on ice pack. The sera were kept at -20°C until tested.

Egg yolk extract

Sixty village chicken eggs were also collected from the study villages. Egg yolk extract was prepared as described by Piela *et al*. (1984).

Hemagglutination inhibition (HI) test

The HI test for the detection of Newcastle disease virus antibodies in village chicken sera and egg yolk extract was performed as described by Allan and Gough (1974). Newcastle disease vaccine LaSota used as the antigen for the test was obtained from the National Veterinary Research Institute (NVRI), Vom, Nigeria. The positive control serum used for the test was a pooled positive NDV HI antibody positive serum with titres 1:640 from natural outbreak of ND in village chickens.

Data analysis

The data generated from this study were subjected to statistical analysis using ANOVA and Student T-test at 5% level of statistical significance.

Results

The results of our study showed that village chickens constitute the highest percentage (62%) of all the livestock reared by farmers in the villages studied, followed by goats (21%), sheep (9.2%), cattle (5.9%), ducks (0.2%) and others (1.7%) (*Table 1*). Also observed in this study was that village chickens have an average flock size of 23, with the average eggs laid per hen per clutch of 13, and an average of 10.6 chicks hatched and an average of only 6 chicks reaching adulthood (*Table 2*). The age distribution of village chickens showed an average of 5 adult females, 3 adult males, 7 growers and 8 chicks. While 80% of our respondents use their chickens for cash income, 96% of them use the eggs from their chickens for breeding (*Table 2*). Most of the farmers (88%) interviewed use mud houses with thatched roofs to house their chickens others (8%) have their birds roosting on tree branches and 4% use other forms of shelter (*Table 3*). The dry-cold Harmattan season has the highest rate (64%) of disease occurrence followed by hot season (24%) and least was in the rainy season (12%) (*Table 3*). When there is an outbreak of a disease among village chickens, the farmers either intervene by slaughtering (40%), selling (12%), treating (12%) or they do not intervene at all (36%) (*Table 3*). It was observed that the highest cause of losses among village chickens in the study villages was diseases (59.7%), followed by predators (23.3%), ectoparasites (16.8%) and stealing (0.2%) (*Table 4*). Significantly ($P<0.05$) more chicks (80.5%) are lost through these causes than the adult chickens (19.5%) (*Table 4*). A statistical difference ($P<0.05$) was observed in the geometric mean titre (GMT) of ND HI antibodies among the different villages with both serum and egg yolk extract (*Tables 5* and *6*). The egg yolk extract recorded higher titres (1:128) than the sera (1:20) (*Table 6*).

Table 1 Distribution of livestock population kept by farmers in five selected villages of Borno State, Nigeria.

	Villages					
Species	Bukardi	Nyamga	Ngulde	Wawataku	Gorgor	Total (%) L/S
Chickens	72	82	134	207	80	575 (62.0)
	(14.4)*	(16.4)	(26.6)	(41.4)	(16.0)	(23.0)
Ducks	-	-	-	2	-	2 (0.2)
Goats	23	45	34	75	18	195 (21.0)
Sheep	47	4	9	23	2	85 (9.2)
Cattle	-	-	47	6	1	54 (5.9)
Others	-	-	10	2	4	16 (1.7)
Total	142	131	234	315	105	927

*Average flock size per village.

Table 2 Village chicken parameters.

	No.	**Average**
a) Age distribution of village chickens		
Adult females	128	5
Adult males	73	3
Growers	178	7
Chicks	190	8
Total	575	23
b) Production status of village chickens		
Eggs per hen per clutch	8 – 18	13
Chicks hatched per clutch	8 – 14	10.6
Chicks raised to adulthood	0 – 11	6
c) Uses of village chickens	% respondents	
	Chickens	Eggs
Income	80	0
Food	8	4
Breeding	4	96
Others	8	0

Table 3 Management of village chickens in selected villages of Borno State, Nigeria.

	Number (%) respondents
a) Type of shelter	
Mud house	22 (88)
Tree branches	2 (8)
Others	1 (4)
b) Feeds	
Sorghum	9 (60)
Millet	5 (33)
Maize	1 (6)
c) Season of disease occurrence	
Cold Harmattan season	16 (64)
Hot season	6 (24)
Rainy season	3 (12)
d) Disease control methods	
Slaughter	10 (40)
Selling	3 (12)
Treatment	3 (12)
No intervention	9 (36)

Table 4 Causes of losses in village chicken population in selected villages of Borno State, Nigeria.

	Chicks	**Adults**	**Total (%)**
Factors			
Diseases	285	43	328 (59.7)
Parasites	58	34	92 (16.8)
Predation	98	30	128 (23.3)
Stealing	-	1	1 (0.2)
Total	441 (80.5%)	107 (19.5%)	549

Table 5 Newcastle disease HI antibodies in the sera of village chickens in selected villages of Borno State, Nigeria.

	No tested	No. of positive (%)	Reciprocal of the end-point titre				
			10	20	40	80	160
Village							
Bukardi	24	8 (33.3)	6	2	-*	-	-
Nyamga	34	6 (17.6)	6	-	-	-	-
Ngulde	52	12 (23.1)	6	6	-	-	-
Wawataku	52	8 (15.4)	2	6	-	-	-
Gorgor	38	12 (31.6)	11	1	-	-	-
Total	200	46 (23.0)	31	15	-	-	-

* Negative at those titres.

Table 6 Newcastle disease HI antibodies in the egg yolk extract of village chicken eggs in selected villages of Borno State, Nigeria.

	No. tested	No. of positive (%)	Reciprocal of the end-point titre						
			2	4	8	16	32	64	128
Village									
Bukardi	10	5 (50.0)	5	-*	-	-	-	-	-
Nyamga	13	11 (84.6)	1	-	-	2	1	3	4
Ngulde	13	2 (15.4)	1	-	1	-	-	-	-
Wawataku	14	2 (14.3)	-	-	-	-	1	1	-
Gorgor	10	8 (80.0)	2	-	1	-	3	2	-
Total	60	28 (46.7)	9	-	2	2	5	6	4

* Negative at those titres.

Discussion

This study showed that village chickens constituted 62% of the total domestic animal population kept by the farmers in the study areas. This is similar to the report by Benabdeljelil and Arfaoui (2000). This therefore shows that improving the village chicken production will have significant positive impact on the development of the rural areas. Village chicken production was observed to be an overall family affair with the women owning 52% and the ones most responsible for the care and management of the birds. This is consistent with the works from Morocco (Benabdeljelil and Arfaoui, 2000) and Botswana (Moreki and Masupu, 2001) who all reported women to dominate village poultry farming. The birds are reared mainly for cash income and to lesser extent for consumption, sacrifice, gift, etc. (Maho *et al*., 2000) reported that the proceeds from the sales of village chickens are used for the purchase of clothes, medicine, soap, kitchen salt, etc. On the other hand, village hen eggs are used mainly for reproduction. Village chickens in this study scavenge for their feeds in and around the owners' compounds, with little feed supplementation by the farmers. This predisposes the birds to predators, thefts and even diseases. The farmers mostly use Guinea corn, millet, maize and ground nuts as supplementary feeds for village chickens. Housing, where provided, is for night shelter only and is mostly made of mud with thatched roofs, old or uncompleted buildings, tree branches, mud pots, baskets, roof tops and the owner's bedroom. Moreki and Masupu (2001) have previously reported lack of specific houses for village chickens. The type of housing used is always too small for the flock and leads to overcrowding and fast spread of diseases, and forms a good hiding place for parasites. Those birds left in the open are also exposed to predation and theft.

The marketing of village chickens in the study areas was done at home; the buyers usually go to the farmers to buy birds although at prices far lower than what the birds would fetch in the urban markets. This agrees with the report of Ekue *et al*. (2002). An adult cock costs between N250-350[§], and an adult female costs between N150-250. Inter and intra village transactions also occur during festivals or other social occasions.

The average number of eggs laid per hen per clutch of 13, and hatchability of 81.5% observed in this study agrees with earlier reports of 10 and 83% in Nigeria (Sonaiya *et al*., 2002) and 14 and 80% in Botswana (Moreki and Masupu, 2001). Chick mortality was found to be very high with only 6 chicks reaching adulthood. Previous reports showed varying figures of 2-4 chicks reach maturity per hen per clutch in Mozambique (Mavale, 2001) and only 7 chicks was reported by Moreki and Masupu (2001) in Botswana. The variations are probably due to the differences in geographical

[§] 1 US$ ≈ 125 Nairas (N)

locations and season of study.

The observation in this report that diseases were the major causes of losses in the village chickens agree with earlier reports by El-Yuguda *et al*. (2005). The farmers try to control diseases by selling, slaughtering, treating the sick chickens or may not even intervene. They use drugs such as oxytetracycline capsules, paracetamol tablets or traditional herbs like onion, pepper, ashes, salt, groundnuts oil, bark of trees, etc. Sometimes the diseases wipe away the entire flocks in the villages, and farmers have to wait for weeks or months before they restock their flocks. The reasons the farmers gave for not vaccinating their chickens included: ignorance of the existence of vaccines against poultry diseases, do not know where to get the vaccines or cannot afford buying the vaccines.

Seroprevalence of ND in village chickens in the study areas was observed to be high in both sera and egg yolk extracts. This complements the findings of Baba *et al*. (1998) who reported high seroprevalence of ND among village chickens in Borno State. However, the high seroprevalence observed in this study is higher than what was reported by El-Yuguda and Baba (2002) who found seroprevalence of ND in village chickens sera and egg yolk extract to be 11% and 10.7% respectively.

The authors are of the opinion that making vaccines and veterinary drugs available and affordable to the village poultry farmer will bring about development, poverty eradication, food security and empowerment of the rural women.

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Egg components, lipid fraction and fatty acid composition of Creole and Plymouth Rock x Rhode Island Red crossed hens fed with three diets

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Summary

Twenty-seven Creole and 27 Plymouth Rock x Rhode Island Red hens (cross) 47 weeks old were used to estimate the effect of three diets; commercial diet, corn + alfalfa and homemade diet on egg weight, white, yolk, egg shell, dry matter, protein, fat and ash content of the yolk and egg shell pores. Lipid fraction and fatty acid profile of the yolk was estimated too. Eggs were collected at 53 weeks of age, 30 eggs per treatment were randomly selected for laboratory analysis. No differences ($P>0.05$) were found on egg, white, yolk and egg shell weight between genetic groups. There was a significant effect of diet on yolk weight in both groups. There was no effect of diet and genetic group on yolk composition ($P>0.05$). However, there was a trend towards lower content of dry matter and higher ash content with the homemade diet in both groups. There was an effect on egg shell pore number for the crossbreed fed on homemade diet. The number of pores in equator was different ($P<0.05$) between groups, but not in the air chamber. There was a diet effect ($P<0.05$) inside groups in both areas. The number of pores increased with diet quality, with the largest number of pores with the homemade diet. There was a group effect ($P<0.05$) on cholesterol, cholesterol esters and lecithin content; inside groups there was a diet effect ($P<0.05$) on total lipid content and triglycerides. No differences ($P>0.05$) between groups were found for the fatty acid profile. Inside the groups, the stearic acid was higher ($P<0.05$) in the yolk of hens fed with homemade diet and linoleic acid percentage was higher ($P<0.05$) with alfalfa plus corn diet. Results indicated that the commercial diet seems to alter the egg components, eggshell quality, yolk lipids and fatty acid profile.

Keywords: Creole hens; white; yolk; eggshell pores; lipids; fatty acids

Introduction

Parallel to the commercial poultry industry, a small-scale production system has been developed and remains attached to the rural communities in developing countries. This kind of production is so-called backyard poultry production; these systems can be an important source of food in the rural areas (Sheldon, 1993). In a study about the future of the world poultry production, Sheldon (2000) stated that research on small-scale poultry production system has to be a priority in the scientific poultry community in years to come. Previously reported data on egg components determined

that eggs are 58% white, 31% yolk and 11% shell (Stadelman and Cotterill, 1997). In addition, breed, age, diet and strain of birds have been reported to cause changes in the content of lipids and fatty acids (Edwards, 1964; Cherian and Sim, 1991; Ahn *et al*., 1995). In Mexico, about 35% of the avian production is under small scale (INEGI, 1998) and is characterized for breeding pullets product of natural selection, known as Creole, or a simple cross of two breeds such as Plymouth Rock x Rhode Island Red, among others. In terms of general management, shelter, health and feeding in the poultry backyard production are very inefficient which, in turn, leads to very low productive and reproductive traits that result in high mortality (Izquierdo, 1994). Duarte (1986) in a survey on a rural community in South Mexico found 78 eggs per hen per year and 75% of mortality; Segura (1998a) reported an average pullet weight of 1.42 kg at 21 weeks old in several breeds in rural areas, and 38.5 weeks to reach sexual maturity. Jerez *et al*. (1994) found chick day-old chick weight ranging from 38.6 to 40.3 g in four groups of Creole hens. In addition, the feedstuffs used are basically grains, forages, crop by-products and kitchen leftovers which are not balanced in terms of reaching the minimum requirements to produce meat, eggs or even reproduction. The objectives of the present study were to compare the lipid fraction, fatty acid composition and egg components of two different breeds; one of them Creole hens that were the commonly found in backyard production systems in rural areas. The husbandry and management conditions in those areas were improved through feeding using three different diets.

Material and methods

Twenty-seven Creole and 27 Plymouth Rock x Rhode Island Red hens (cross) 47 weeks old were used to estimate the effect of three diets; commercial diet, corn + alfalfa and homemade diet on egg, white, yolk, and egg shell weight; dry matter, protein, fat and ash content of the yolk and number of egg shell pores of the equator and air chamber area; lipid fraction and fatty acid profile of the yolk. Proximal analysis was performed to diets according to AOAC (1984), and the results are presented in *Table 1*. The experiment lasted 7 weeks, during which layers were fed on an *ad libitum* basis and had free access to water. Hens had a two-week adaptation process to the diets. Eggs were collected at 53 weeks of age, from these, 30 eggs per treatment were randomly selected for laboratory analysis of the variables mentioned above.

Table 1 Analyzed composition* of the experimental diets.

Item	Control	Alfalfa+Corn	Homemade
DM	89.88	67.21	23.80
Ash	10.98	5.05	1.60
Crude protein	19.63	14.98	13.80
Ether extract	2.81	2.59	1.66
Fatty acids			
Palmitic	8.45	11.64	12.06
Stearic	3.82	2.88	3.59
Oleic	48.59	26.87	31.17
Linoleic	27.01	53.50	50.11
Linolenic	12.11	5.08	3.04
Lipids			
Triglycerides	59.79	55.15	52.94
Phospholipids	32.03	35.41	38.52
Lecithin	27.33	30.61	34.02
Cephalin	4.70	4.8	4.50
Cholesterol	6.09	6.69	5.80
Cholesterol esters	2.09	2.78	2.74

*(%DM)

The eggs were weighed, and the yolks were separated with an egg separator and weighed. The shell was wiped, clean and weighed. The albumen weight was calculated by subtracting yolk and shell weight from total egg weight. Yolk composition (DM, protein, fat and ash) were determined according to AOAC (1990). The yolk samples were pooled in a plastic bag, blended thoroughly and stored for lipid analysis.

Egg shell pores

The technique developed by Rhan (1981) was used to determine the number of egg shell pores. Representative sections of the air chamber and equator (mid part of the egg) were taken. Each section was boiled in a solution of 5% NaOH for 15 minutes, washed and dried to air temperature, then it was submerged in butyric acid for 9 seconds, washed and dried to air temperature. Finally it was dye in a 0.5% methylene blue solution and dried. The pore number was summarized in an area of 0.25 cm^2 with a microscope with 4x lens.

Lipid fraction and fatty acid profile of the egg yolk

Lipid extraction was performed according to Folch *et al*. (1957) with a Folch-I solution chloroform:methanol 2:1 vol/vol. From the extract 37 to 40 mg samples were taken to separate the mixture in the following fractions: triglycerides, free cholesterol, cholesterol esters and phospholipids by thin layer chromatography (TLC) in chromatoplates coated of silica gel G 10 x 10 cm, 0.5 cm (Sigma ZIZ-276). Lipids were identified using pure soybean oil, L-α-phosphatidylcholine L-α-lecithin type XVI-E (Sigma P-9671) from egg yolk, L-α-phosphatidylethanolamine L-α-cephalin type III (Sigma P-7943) from egg yolk, cholesterol, 5-cholesten-3-ol (Sigma C-1145) and cholesteryl linoleate, 5-cholesten-3β-ol-linoleate (C-0289) as standards. The chromatoplates were developed in a hexane:ether diethyl:formic acid (80:20:1 vol/vol/vol) system according to Noble *et al.* (1986).

To determine the phospholipid fraction, samples were developed in a chloroform:methanol:acetic acid:water (25:15:4:2 vol/vol/vol/vol) system (Noble *et al.*, 1986). Fractions were quantified using a densitometer[**]. Fatty acids samples from the triglycerides fraction were methyled with sodium methoxide; from this 1 µl was injected to a fused silica capillary column (30 m x 0.32 mm x 0.25 µm)[2] on a Hewlett-Packard 68960[††] gas chromatograph, equipped with an auto sampler and a flame ionization detector, was used to separate and quantify the fatty acid methyl esters. The initial column temperature was set at 180°C, held for 1 minute, and then increased by 20°C/minute until 240°C was reached and then held for 7 minutes (Cherian and Sim, 1992). Nitrogen was used as the carrier gas at a flow rate of 3.0 mL/minute. Fatty acid methyl esters were identified by comparison with retention times of authentic standards[‡‡]. Peak areas and percentages were calculated using Hewlett-Packard ChemStation software[§§]. We reported fatty acid content of egg yolk as a percentage.

[**] Varian Instruments, San Fernando, CA 91340.

[††] Hewlett-Packard Company, Wilmington, DE 16808-1610.

[‡‡] Nuchek, Elysian, MN 56028.

[§§] Hewlett-Packard Company, Palo Alto, CA 94304.

Experimental design 2 X 3 factorial arrangement (two breeds and three diets), data from fatty acids were transformed to Arsin function before analysis, ANOVA and orthogonal contrasts were analyzed by general linear model procedure, differences by means were identified by using Tukey's Least Square Means (LSM) comparisons using SAS (1991).

Results and discussion

Results of egg components and proximate analysis of yolks are shown in *Table 2*. No differences (P>0.05) were found in egg weight between breeds, however, there were differences (P<0.05) in egg, white and yolk weight inside groups according to the diet quality, these data are similar to those found by Stadelman and Cotterill (1977). The proximate analysis of egg yolks showed no differences between breeds and inside breeds, however, there was a trend whit least dry matter and fat in egg yolks from hens fed homemade diet, this probably due to less lipid content (triglycerids) as shown is *Table 1*. The pore number of egg shells (*Table 2*) indicate differences (P<0.05) between breeds in the equator area, but not in the air chamber area of the egg. When comparing breeds there was a diet effect in both areas, since the pore number increased according to the diet quality, with more pores in the eggs of hens fed homemade diet, which make them easy to break when handling.

Table 2 Egg components, proximate analysis of egg yolks and number of eggshell pores.

Treatment*	Egg weight	White	Yolk	Shell	DM	Protein	Fat	Ash	Equator	Air chamber
	g	%			g				No. pores/ 0.25 cm^2	
Creole										
Commercial diet(1)	57.40	55.17	31.18	13.29	7.61	2.70	4.64	0.278	35.51	31.02
Alfalfa+corn(2)	56.30	55.41	31.26	13.32	7.66	2.69	4.69	0.283	36.74	41.29
Homemade(3)	50.20	57.17	29.28	13.54	7.56	2.65	4.58	0.333	37.38	44.37
Cross										
Commercial diet(1)	56.90	54.72	31.10	13.70	7.64	2.67	4.67	0.303	30.42	32.44
Alfalfa+corn(2)	55.20	56.70	30.25	13.04	7.51	2.68	4.53	0.300	35.91	41.02
Homemade diet(3)	50.60	55.73	29.64	14.62	7.27	2.72	4.25	0.308	38.41	44.82
SEM	1.50	1.05	0.53	0.23	0.26	0.08	0.16	0.10	0.90	0.85
					Probability (α)					
1+2+3 vs 4+5+6	NS	NS	NS	NS	NS	NS	NS	NS	0.01	NS
1 vs 2+3	NS	NS	NS	NS	0.03	NS	NS	0.04	0.01	0.01
2 vs 3	0.03	NS	0.01	NS	0.04	NS	NS	0.03	0.02	0.01
4 vs 5+6	NS	NS	NS	NS	NS	NS	0.03	NS	0.01	0.01
5 vs 6	0.01	0.01	0.02	NS	NS	NS	NS	NS	0.01	0.01

*Figures between parentheses used to compare orthogonal contrasts.

Lipid fraction of egg yolks are presented in *Table 3*. There were differences (P<0.05) between breeds in cholesterol, cholesterol esters and lecithin, but not in total lipids, triglycerides and cephalin. Inside breed there were differences (P<0.05) in total lipids, cholesterol, lecithin and triglycerides which decreased according to diet quality. Inside the Creole group, hens fed with homemade diet had least (P<0.05) cholesterol yolk content than those fed a commercial diet. Triglycerides are the major lipid class in egg yolk, however the results observed in this experiment in total lipid and triglycerides are lower than those reported by Awad *et al*. (1997), namely 6100 mg and 3900 mg respectively. These results showed that there was a breed effect (P<0.05) in the cholesterol yolk content, it might be suggested that the cholesterol content can be explained by a genetic effect. Breed, diet and strain have been reported to cause changes in cholesterol content in egg yolk (Washburn and Nix, 1974; Sheridan *et al*., 1982; Hargis, 1988; Shafey *et al*., 1992). Hall and McKay (1992) reported a pattern variation of cholesterol yolk content in five strains of commercial strain hens and

one cross, and found that the cholesterol concentration was lower in the cross. The phospholipid content in egg yolk observed in this experiment was similar to those found in the literature 1250 mg lecithin and 432 mg cephalin (Noble and Moore, 1965).

Table 3 Least square means of lipid fraction content of egg yolks[1].

Treatment[2]	TL[3]	TG	CHO	CHE	LE	CE
	Mg	mg/g solids				
Creole						
Commercial diet(1)	5150	0.465	0.061	0.040	0.271	0.050
Alfalfa+corn(2)	4720	0.467	0.068	0.047	0.312	0.052
Homemade(3)	4220	0.389	0.063	0.040	0.290	0.050
Cross						
Commercial diet(1)	5040	0.402	0.106	0.072	0.288	0.046
Alfalfa+corn(2)	4440	0.518	0.102	0.046	0.230	0.067
Homemade diet(3)	4130	0.400	0.127	0.078	0.240	0.091
SEM	173.85	0.02	0.01	0.006	0.06	0.007
			Probability (α)			
1+2+3 vs 4+5+6	NS	NS	0.01	0.01	0.04	NS
1 vs 2+3	0.02	NS	NS	NS	NS	NS
2 vs 3	NS	NS	NS	NS	NS	NS
4 vs 5+6	0.01	NS	NS	NS	0.04	NS
5 vs 6	NS	0.01	0.01	NS	NS	NS

[1]Liophilized material.
[2]Number between parentheses used to compare orthogonal contrasts.
[3]TL=Total lipids, TG=Triglycerides, CHO=Cholesterol, CHE=Cholesterol esters, LE=Lecithin, CE=Cephalin.

There were no significant differences (P>0.05) between genetic group in fatty acid profile of egg yolks as shown in *Table 4*. However, inside the groups, there were significant differences (P<0.05) for stearic acid between egg yolks from Creole hens fed with commercial diet and alternative diet; same trend was found with Cross hens. The egg yolk from hens fed homemade diet had least (P<0.05) linoleic acid content for both breeds. Linoleic and linolenic acids are essential fatty acids and can not be synthesized by the hen (Noble and Moore, 1964), linoleic acid is a precursor of arachidonic acid which in turn form several hormones for proper metabolism and tissue development (Sturkie, 1986) so it must be included in the diet. Studies including high levels of oleic and linoleic acids in the diet increased the fatty acid profile in hen egg yolks (Ding and Lilburn, 1997; Jiang *et al*., 1991; Vilchez *et al*., 1990, 1991; Shafey *et al*., 1992; Scheideler *et al*., 1998). Results of the present study showed that there is a strong effect of breed and strain in terms of egg components, also the diet is very important in the lipid and fatty acid profile of the egg yolks from these hens.

Table 4 Percentage[1] of major fatty acid composition of egg yolks[2].

Treatment[3]	Palmitic	Stearic	Oleic	Linoleic	Linolenic
			%		
Creole					
Commercial diet(1)	25.6	9.2	50.0	13.6	0.35
Alfalfa+corn(2)	27.5	10.1	45.0	15.6	0.44
Homemade(3)	29.5	10.5	46.5	12.1	0.44
Cross					
Commercial diet(1)	27.0	8.4	50.0	13.2	0.40
Alfalfa+corn(2)	27.0	11.0	47.3	13.1	0.35
Homemade diet(3)	26.5	11.1	50.6	10.3	0.34
SEM	0.18	0.21	0.32	0.38	0.38
			Probability (α)		
1+2+3 vs 4+5+6	NS	NS	NS	NS	NS
1 vs 2+3	0.05	0.02	0.05	NS	NS
2 vs 3	NS	NS	NS	0.01	NS
4 vs 5+6	NS	0.01	NS	NS	NS
5 vs 6	NS	NS	NS	0.04	NS

[1]Data transformed arcsine function.
[2]Liophilized material.
[3]Number between parentheses used to compare orthogonal contrasts.

Conclusion

The results indicated that no commercial diet seems to alter the egg components, eggshell quality, yolk lipids and fatty acid profile, which can be one of the reasons of the low productive efficiency in hens raised in backyard poultry systems. However, Creole hens have a good potential to supply animal protein in terms of meat and eggs to rural areas, research has to be done in the use of local feed resources available to hens in rural areas, as an alternative to commercial feed which is not economical feasible for many breeders in these areas.

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Rural chicken production: constraints limiting rural chicken production in some areas of Nigeria and Cameroon

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Summary

A study of village poultry production system was carried out in West Province of Cameroon and some parts of Borno state, Nigeria, focused on the constraints that limit production including the causes of mortality and the means of control. The results showed that farmers keep different livestock species, rural chickens were predominant (31% and 51%) in West Province of Cameroon and some parts of Nigeria's Borno State, respectively. However, there was also a relatively higher percentage (32%) of culled layers and broilers in West Province of Cameroon. Disease incidence and predation were found to be the major causes of loss. Disease accounted for 63% and 77% in West Province of Cameroon and some parts of Borno State respectively, while predation accounted for 30% and 16% in West Province of Cameroon and some part of Borno State respectively. Farmers combined salvage sells, ethnoveterinary therapy and consumption via slaughter as means of disease control. The survey further revealed that majority of farmers kept village chickens as a ready source of income in both areas.

Keywords: rural chicken; limiting production; Cameroon; Nigeria

Introduction

Rural poultry production systems in Nigeria, Cameroon and even the whole of Africa are based on the scavenging indigenous domestic fowl, which is the predominant species of the poultry sector (Kitalyi, 1998). The rural poultry production constitutes an extreme case of extensive system of management, whereby the birds are exposed to a variety of infectious agents and adverse climatic conditions (Ambali *et al*., 2003). The scavenging chickens have no regular disease control programme, because the use of conventional vaccines for the control of infectious diseases among their scattered populations poses difficult logistic problems. They may or may not have shelter and usually have to scavenge around for their nutritional requirements including feeds (Amin *et al*., 1999; Kwenkan *et al*., 2001). It is said that about 80% of poultry are found in rural areas these are raised under the free-range system (Sonaiya, 1998). Rural poultry also fulfils a number of other functions for which it is difficult to assign any monetary value. These include the fact that rural poultry play an active role in pest control and are used for traditional ceremonies and festivals (Alders and Spradbrow, 2001).

The importance of rural poultry in the national economy of developing countries and its role in improving the nutritional status and income of many small communities has been very significant (Creevey, 1991; FAO, 1997). Strategic increases in the productivity of rural chicken flocks will therefore greatly assist in poverty alleviation, and improve household food – security and protein intake in rural communities (Ambali *et al*., 2003). However, production levels of rural poultry in many African countries are far below desirable levels mainly due to the menace of infectious diseases and predation.

Therefore this study aims at identifying some of these constraints limiting rural poultry production in West Cameroon and some parts of Nigeria's Borno State with the aim of suggesting improvement strategies.

Material and methods

Study areas

The study was carried out in the West Province of Cameroon and Borno State of Nigeria. Cameroon is broadly divided into four regions namely: North, South, littoral and West. These regions constitute of 10 provinces that share international borders with Chad to the North, Gabon to the South, Congo to the South – West and Nigeria to the West. The Western region is made up of West and North provinces, located in savannah type of vegetation. It shares border with Taraba State, Nigeria.

Borno State is located in the extreme North-Eastern Nigeria and shares international borders with Cameroon, Chad and Niger Republic to the East, North-East and North, respectively. It also shares national boundaries with Adamawa, Gombe and Yobe States. The inhabitants are mainly farmers and traders. It is located in Sudano-Sahelian vegetation zone (Ehumere, 1987).

Sampling method / Questionnaire survey

A stratified sampling technique was employed in administrating standard questionnaires, as prepared by Alders and Spradbrow (2001). It was used to identify some of the constraints limiting rural poultry production in West Cameroon and some parts of Borno State, Nigeria. The West Province was divided into four quadrants namely: North-East, South-West, South-East and North-West, three villages were selected at random from each of the four quadrants and five households from each village, which amounts to a total of 60 households or experimental units. In Borno State, Nigeria, three local government areas (LGA) were selected randomly and 6 households were chosen in each of the local government headquarters making a total of 18 households. Questionnaires were administered in 3 LGA namely: Maiduguri, Konduga and Mafa, and 12 villages in West Province of Cameroon. The selection of the farmers for administration of questionnaires was based on advice of the village extension service officer, taking into consideration the previous cooperation of the farmers to such an exercise. The questionnaires evaluate the type of livestock kept, causes of mortality, method of disease control used and contribution of rural chickens and their by-products to rural farmers' economy.

Data analysis

Appropriate statistical method was used in analyzing the data generated from the questionnaires survey.

Results

The result of this survey revealed that chickens constituted the highest number of domestic animals kept by farmers in provinces of Cameroon and Borno State of Nigeria, constituting 35.4% and 51.5% of the total domestic animal species. Other domestic animals raised such as ducks, rabbits, sheep, goats and Guinea pigs are also kept but in relatively few numbers, constituting between 2.7-10.0% in West Province of Cameroon and 5.5-26.5% in Borno State of Nigeria. However, culled layers/broilers were also kept in large numbers. Statistically significant differences between the village chicken population ($p<0.05$) and other domestic animal species kept were observed in the study area (*Tables 1* and *2*).

Table l Domestic animals kept in West Province of Cameroon.

Animal species	Number of domestic animals per household				Total (%)
	North East	South West	South East	North West	
Rural chickens	40	40	50	25	155 (35.38)
Ducks	7	1	5	5	18 (4.10)
Pigs	8	3	4	4	19 (4.3)
Goats	8	1	3	8	20 (4.5)
Sheep	2	-	10	-	12 (2.73)
Rabbits	22	4	8	10	44 (10.04)
Guinea pigs	13	-	4	14	31 (7.07)
Culled layers/broilers	37	34	36	32	139 (31.73)

Table 2 Domestic animals kept in some LGA of Borno State, Nigeria.

Animal species	Number of domestic animals per household			Total (%)
	Maiduguri	Konduga	Mafa	
Rural chickens	10	10	15	35 (51.47)
Goats	4	2	5	11 (16.17)
Sheep	5	6	7	18 (26.47)
Rabbits	4	-	-	4 (5.8)

Disease incidence was found to be the main cause of chicken loss followed by predation in both West Province of Cameroon and Borno State of Nigeria (*Table 3*). Disease control measures included: treatment, sale, consumption/ treatment, consumption/sale and no action taken (*Tables 4* and *5*). In general, 36.7% of farmers combined sale, treatment and consumption as means of disease control, followed by 20% who used treatment of sick animals (with conventional medicines). Ethnoveterinary practices were more extensively used in West Province of Cameroon because of easy accessibility and relatively low cost of material used. In Borno State, disease control was achieved mainly by consumption (38.88%), followed by sale (11.11%) and treatment (11.11%), combination of consumption and treatment was (11.11%), whereas 33.33% do not take any action in the case of disease.

Table 3 Causes of mortality in rural chickens in West Province of Cameroon and some selected LGA in Borno State of Nigeria.

Location	Disease No. (%)	Bird prey No. (%)	Cat/dog No. (%)	Theft No. (%)
West Province, Cameroon				
North East	119 (51.51)	68 (29.43)	14 (6.06)	30 (12.98)
South West	189 (84.70)	80 (27.2)	15 (5.1)	10 (3.4)
South East	140 (66.3)	53 (25.1)	3 (1.42)	15 (7.1)
North West	128 (49.23)	107 (41.15)	5 (1.92)	20 (7.6)
Borno State, Nigeria				
	123 (76.39)	8 (4.96)	3 (18.63)	-
	130 (81.25)	30 (18.75)	-	-
	74.6 (72.27)	28 (24.77)	-	12 (10.68)

Table 4 Methods of disease control in rural chickens in West province of Cameroon.

Location	Method						
	Consump-tion/Treatment	Sale	Slaughter-ing/Consumption	Consump-tion/Sale/Treatment	Treat-ment	Sale/ Treat-ment	Consump-tion/Sale
North East	1	2	1	9	2	-	-
South West	3	1	-	-	8	3	-
South East	3	-	-	5	2	1	4
North West	1	1	-	8	-	3	2

Table 5 Methods of disease control in rural chickens in some LGA in Borno State of Nigeria.

Location	Method					
	Consumption	Sale	Treatment	Consump-tion/Treatment	No action	Total
Maiduguri	2	-	2	1	1	6
Konduga	2	-	-	1	3	6
Mafa	3	2	-	-	1	6

Discussion

The result of this survey has shown that farmers raised rural poultry in addition to other domestic animal species in West Province of Cameroon and Borno State of Nigeria. They practiced extensive management system with relatively few numbers of different domestic animal species such as sheep, goats, Guinea pigs and rabbits. According to respondents, despite this relative few number of each species, this diversification increased their chance of success. Rural poultry constituted the highest number of livestock in both areas. This finding agrees with previous works on village chicken production systems in the area (Ekue *et al*., 2002; Ambali, 2003) and in other African countries such as Mali (Kuit *et al*., 1986), Ghana (Van Veluw, 1987), Burkina Faso (Bourzat and Saunder 1990), Togo (Aklobessi, 1990) and Niger (Abdou and Bell, 1992). These chickens scavenge for most of their nutritional needs with occasional feed supplements from home-grown cereals and household refuse. They may or may not have shelter and have little or no regular health control programme. Consequently, production is low and chances of survival rate are equally slim. This agrees with findings reported by Ekue *et al*. (2002).

In Cameroon, a competition was observed between rural chickens (35.38%) and culled layer/broilers (31.73%). This could be attributed to the fact that culled layers and broilers have better resistance during disease outbreak because of regular health control programme, compared with rural chickens. The better resistance of culled birds may be due to the vaccine received during early stages of their development under intensive management system. However, ethnoveterinary therapy featured as the most frequent method of disease control, in conjunction with slaughter (eating) and selling among rural poultry in Cameroon and Nigeria where the principal cause of chicken loss has been attributed to disease and predation. This finding also agrees with earlier works of Chabeuf (1990) and Ambali (2003). Ekue *et al*. (2002) reported that ethnoveterinary practices were common in rural poultry production because of the almost complete absence of assistance from extension services and the ease and low cost of acquiring ethnoveterinary substances. However, this method of therapy is associated with very little success their efficacy requires further investigation.

Disease incidence has been found to be the principal cause of chicken loss. Other causes included predation, cold and starvation. These could be prevented by proper management in terms of housing, healthcare and improvement in feeding systems. Pest and disease have long been a threat to successful village poultry rearing in rural areas. Village chickens are used by the peasant farmers as source of income to supplement their diet and as means of celebrations and rituals. This shows that the rural chickens play a very important role in the livelihood of rural farmers in Cameroon and Nigeria.

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FAO International Conference on "Poultry in the 21st Century" in Bangkok, Thailand *[5-7 November 2007]*

The global poultry sector indicates the fastest growth in consumption and trade of all the major agricultural commodities. It is also a sector that currently has the highest public profile and one that faces major changes and challenges, not least from the Highly Pathogenic Avian Influenza (HPAI). It is in this context that the Animal Production and Health Division of the Food and Agriculture Organization of the United Nations (FAO) organized an international conference on the theme "Poultry in the 21st Century". The event was held in the Amari Watergate Hotel & Spa in Bangkok, Thailand, from 5 to 7 November 2007. It was attended by around 90 participants from 26 countries, who were representatives of a broad range of senior managers from the public, private and non-government sectors that have an interest in all aspects of poultry production, including the research, the development and donor communities. The objective of the Conference was to review the global poultry sector in its entirety, to assess past development, the current situation and development 'hot spots', and to explore scenarios for its future. The emphasis was to focus on the expected social, environmental and animal/human health implications of changes and, in doing so; policy measures to address the consequences of such changes were identified. Some of the myths and misunderstandings commonly associated with poultry production today were also addressed.

The Conference was structured upon three main sessions: 'Sector Trends and Impacts', 'Risks and Challenges for Poultry Production' and 'Poultry as a Development Tool'. The main sessions and papers were complemented with short presentations by invited speakers. Each main session was accompanied by plenary discussions. Facilities were made available for posters, stands and 'breakout groups', and there was ample opportunity for the diverse range of participants to interact professionally and socially.

The factors that have driven the development of the poultry sector were identified and described along with regional differences and the trade in poultry products and feed. Advances in breeding, feeding, management and processing were described along with their social, environmental and health impact. The risks of HPAI and other poultry zoonoses were analysed along with their impact on production systems and consumption. Policy and technology options that address the social, environmental and animal/human health consequences of changes were identified, and their implications assessed.

The main presentations, findings and conclusions will be published as conference proceedings. The information arising from the Conference will also provide the material for a major FAO publication on the future of the global poultry sector to be published in 2008.

For further information, please contact:

Animal Health and Production Division, FAO Headquarters, Viale delle Terme di Caracalla, Rome 00153, Italy
E-mail: <poultry21century@fao.org>

Full details are also available on the Conference website: *www.fao.org/ag/poultry21century.html*

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XXIII World's Poultry Congress in Brisbane, Australia *[30 June - 4 July 2008]*

The Organising Committee has great pleasure in extending a warm invitation to everyone with interests in the poultry and allied industries to attend the 23rd World's Poultry Congress (WPC2008), which will be held at the Brisbane Convention and Exhibition Centre in Brisbane, Queensland, Australia, from 30 June to 4 July 2008. The scientific and technical program will be topical and relevant to the needs of the poultry industries in 2008. Speakers with expertise in identified areas of interest and importance to industry, science and technology will be invited to share their knowledge with delegates in both plenary and symposia sessions. Contributed papers will be critical to the success of the meeting, and the organising committee are receiving submissions across a wide spectrum of activity relevant to the future development of poultry science and the poultry industries.

The WPC2008, which has English as official language, promises to offer a comprehensive and exciting educational and social program which, it is anticipated, will attract record delegate numbers. The plenary sessions with outstanding speakers will address some of the important issues facing the global poultry industry in 2008 and beyond. The scientific program of the congress will address the themes listed in the provisional program. The program will include concurrent symposia and poster sessions to cover all areas of poultry science and technology including sessions of direct relevance to poultry meat and egg producers (i.e. Welfare, Husbandry and the Environment; Nutrition and Feed Technologies; Bird Health and Disease; Processing and Product Safety; Economics and Marketing; Education and Extension; Genetics and Breeding; Physiology and Reproduction; Egg Processing and Egg Products; Alternative Management Systems; etc.). The Congress organisers are keen to encourage poultry scientists, technologists and industry personnel from around the world to submit papers for presentation at the Congress. The Organising Committee is very pleased to announce that the 6th Asian-Pacific Poultry Health Conference (AP6), the 4th International Ratite Science Symposium (4IRSS) and the 2008 Australian Poultry Information Exchange (PIX2008), will run concurrently with the Congress. The Congress program has been closely integrated with these affiliations, with AP6 primarily covering the Bird Health and Disease stream. There will also be two satellite meetings taking place in conjunction with WPC2008; the 10th Avian Immunology Research Group meeting to be held from the 26 to 29 June at the Gold Coast and the 8th International Marek's Disease Symposium to be held from the 6 to 10 of July in Townsville, North Queensland in the week following the Congress.

The Congress social program and extensive trade exhibition (the largest ever staged in Australia), will provide an ideal opportunity to meet colleagues and industry associates in a relaxed environment. Brisbane at that time of year is typically mild (12 to 24°C) and sunny. We encourage you to make the very most of your visit and stay on a few days (or come early) to experience everything Brisbane and Australia have to offer. Located in the heart of Brisbane, the venue for this major international event is modern and beautiful.
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Please note the following important key dates:

– Call for abstracts: Deadline has now passed
– Abstract submission deadline: 30 September 2007
– Registration available: October 2007
– Earlybird registration deadline: 29 February 2008
– World's Poultry Congress 2008: 30 June to 4 July 2008

For further details, please visit the Congress website (www.wpc2008.com) or contact the organizers at:

WPC 2008, C/- Event Planners Australia, P.O. Box 1280, Milton Qld 4064, Australia
Tel: +61 (0)7 3858 5594, Facsimile: +61 (0)7 3858 5499, E-mail: <wpc2008@im.com.au>

To download a copy of the latest announcement, please click on the following link:
ftp://ftp.im.com.au/wpc08/3rdAnnouncement.pdf

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