ASSESSMENT OF BREEDING PRACTICES OF SOME SELECTED INDIGENOUS CHICKEN PRODUCERS IN SELECTED LOCAL GOVERNMENT AREAS OF KADUNA STATE, NIGERIA

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(SPS/12/MAS/00006)

B. AGRICULTURE

A Dissertation Submitted to the Department of Animal Science, Bayero University, Kano in Partial Fulfillment of the Requirements for The Award of the Degree of MASTER OF SCIENCE IN ANIMAL SCIENCE

OCTOBER, 2016.

DECLARATION

I hereby declare that this work is the product of my research efforts, undertaken under the supervision of Professor Ibrahim Tahir and has not been presented anywhere for the award of degree or certificate. All sources have been duly acknowledged.

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CERTIFICATION

This is to certify that the research work for this dissertation and the subsequent write-up (Amos Yarwinum Gaba SPS/12/MAS/00006) were carried out under my supervision.

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APPROVAL

This dissertation has been examined and approved for the award of Masters in (Animal Science).

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DEDICATION

I dedicate this work to my lovely wife; you are wonderful for standing by my side, in your patience, love, support, prayers and encouragement.

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ABSTRACT

The study was conducted in three Local Government areas of Kaduna state of Nigeria, namely Chikun, Kajuru and Kachia to assess the breeding practices, selection criteria and trait preferences of indigenous chicken farmers with a view to identify areas of intervention for genetic improvement. A purposive sampling technique was used to select 300 farmers from the study area. A semi-structured questionnaire and focused group discussion were used to generate the required data. Majority (71%) of the respondents purchased the birds used as foundation stock from markets. Flocks were dominated by chicks (8.42±0.45), followed by hens (6.55±0.442) and grower chickens (6.39±0.719), while cocks had the least flock subclass mean of 3.82±0.31. Only 18% of the respondents had breeding experience either by adopting crossbreeding (31%) or line breeding (69%). Live-weight was the most (62.6%) preferred trait, followed by egg number (14.3%). A combination of live-weight and plumage colour was the most frequently (89.7%) mentioned criterion for selecting breeding cocks. Majority (37%) of farmers emphasized on egg production performance during selection of replacement hens. Most (90%) of the farmers observed natural mating in their flocks. Majority (95%) of the respondents did not practice egg selection prior to incubation, while only 5% did so based on egg size. Most (79%) of the farmers did not select broody hens for egg incubation, while 21% adopted the practice. None of the respondents had access to extension services. The study has shown that although breeding and selection practices were generally low among indigenous chicken farmers, they had preferences for high meat yield and egg production. A community based breeding programme for improving the productivity of native chickens that would target these traits is therefore recommended.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Chickens are considered as one of the most important and widely distributed avian species among poultry birds and it is a very good source of animal protein for human consumption (Kumar, Saiful and Ashraful, 2013). The local or village chickens are the commonly known domestic fowls found scavenging around the vicinities of rural communities in most developing countries; they account for the majority of poultry products in Nigeria. The indigenous chicken flocks usually comprise between 5 - 20 birds kept by one family. They are most often managed by the women who provide them with an independent source of income (Ikani and Annatte, 2000). They explained that the indigenous chicken production system in rural areas has been ridiculed because of the low biological productivity (egg and meat) relative to the commercial/industrial poultry production system. Therefore, most poultry improvement programs in Nigeria in the past years were directed toward introduction of specialized or exotic breeds, crossbreeding and management intensification (Ikani and Annatte, 2000).

Although there has been considerable measurable improvement in egg and poultry meat production, indigenous chicken production systems dominate in the rural areas. High mortality of introduced breeds, low feed resources and lack of understanding of the complex biological and socio economic relationships have limited success of most of the programs (Ikani and Annatte, 2000).

Sonaiya and Swan (2004) defined rural poultry as a flock of less than 100 birds, of unimproved or improved breed, raised in either extensive or intensive farming systems. Family poultry was additionally clarified by the authors as “small

flocks managed by individual farm families in order to obtain food security, income and gainful employment for women and children". They explained that family poultry is quite distinct from medium to large-scale commercial poultry farming. Family poultry is rarely the sole means of livelihood for the family but is one of a number of integrated and complementary farming activities contributing to the overall well-being of the household. Poultry provide a major income-generating activity from the sale of birds and eggs. Occasional consumption provides a valuable source of protein in the diet. Poultry also play an important socio-cultural role in many societies. Poultry keeping uses family labor, and women (who often own as well as look after the family flock) are major beneficiaries. Women often have an important role in the development of family poultry production as extension workers and in vaccination programs (Sonaiya and Swan, 2004).

Ajayi and Agaviezor (2009) characterized Nigeria indigenous chickens along genetic line of feather and plumage colour (such as normal or frizzled feather), body structure (such as naked neck, dwarf types) and colour variants (such as black, white, brown, mottled etc). The frequency distribution of the normal feathered chicken was about 91.8% while that of frizzled and naked neck were 5.2 and 3.0% respectively in Bayelsa state of Nigeria.

Ajayi and Agaviezor, (2009) classified Nigeria indigenous chickens bases on locations, with various ecotypes of the local chicken in the different agro ecological zones in Nigeria as reported by different authors. Most of the classification in the different agro ecological zones considered mainly the normal feathered indigenous because they are the most prominent, whereas the naked neck and the frizzled feathered are rare and almost becoming endangered and the gene pool they represent may be lost if not characterized and conserved. For instance, Olori, (2009) noted two

ecotypes characterized as forest and savannah or Yoruba and Fulani ecotypes, respectively. Nwosu (1979), identified three main strains in ecotype namely Nsukka, Owerri, and Awgu types in the South Eastern states of Nigeria. Oluyemi, Longe and Sunga (1982) also reported variation in many traits of the indigenous chicken from the Southern region of Nigeria which they found to be different from those of other parts of the country. It was agreed by all these researchers that the Nigerian chicken is a light breed, often with single comb and that black and brown plumage, laced with various colours such as mottled are common (Adebambo, 2005).

Momoh, Ehiobu and Nwosu (2007) revealed that the different ecotypes can be grouped into two major categories on the basis of body size and body weight as heavy ecotype and light ecotype. The heavy ecotype (also known as Fulani ecotype) is found in the dry savannah (Guinea and Sahel Savannah), montane regions and kraals of the north and weigh about 0.9-2.5kg at maturity. The light ecotype are those chicken types from the swamp, rainforest and dry savannah agro-ecological zones whose mature body weight range between 0.68-1.5kg (Momoh, Ehiobu and Nwosu, 2007).

Nigerian Indigenous Chickens constitutes about 80 percent of the 166 million poultry birds in Nigeria (FAO, 2007). FAO (2001) and Adene (2004) reported that indigenous chickens exhibit large variations in body size, plumage color, feathering pattern, eggshell, earlobe and shank color. Nigerian Indigenous Chickens represent valuable resources for livestock development because of their extensive genetic diversity, which allows for the rearing of poultry under varied environmental conditions. Poultry is efficient in transforming feed into human food and interestingly, requires low capital investment in comparison with the larger animals, with no religious or social taboos and its products do not require storage and preservation facilities for family consumption. Their meat and eggs are preferred widely by

consumers because of their taste, leanness, and suitability for special dishes (Akinleye, Bello, Oyedepo, Eruvbetine and Fanimo, 2011). These qualities have made Nigerian Indigenous Chickens attractive in the context of poverty alleviation and protein supply (Orheruata, Adegbite and Okpeku, 2006). In Nigeria, smallholders keep local chicken for their socio- religious functions. Plumage color, sex, comb type, feather cover and age of bird are important criteria of selection for socio-religious functions. This is because the commitment of an individual/community to a particular spiritual being, deity or season and traditional and /or religious festivals are evaluated by the quality of the offering that satisfies special morphological features of the chicken demanded by the receivers. Recent studies, relating to the development of the Nigerian Indigenous Chickens as a potential layers have shown appreciable improvement in egg production traits under intensive management system (Oleforuh-Okoleh, Nwosu, Adeolu, Udeh, Uberu and Ndofor-Foleng, 2012). Evidence indicates that breeds and populations that have evolved over the centuries in diverse, stressful, tropical environments have a range of unique adaptive traits (e.g. resistance to diseases, adaptation to heat and solar radiation, tolerance to water scarcity, ability to use low quality feed, etc.). These traits enable them to survive and be productive in harsh environments (Gizaw, *et al.,* 2013). Within-breed selection of the adapted indigenous genotypes is a viable and promising strategy for efficient, sustainable, on-farm conservation and use, which ensures a contribution to the economy of communities depending on them (Gizaw, Komen and Van Arendonk, 2008).

Formulation of acceptable and viable breeding programs for low-input, traditional, and subsistence production systems requires characterization of the production systems, particularly the indigenous breeding strategies of communities,

and include identification of their breeding objectives in a participatory and comprehensive approach (Gizaw *et al.,* 2013).

1.2 PROBLEM STATEMENT

Although there has been a considerable improvement in eggs and poultry meat production, village chicken production systems dominate the rural areas. High mortality of introduced breeds, low feed resources and lack of understanding of the complex biological and socio economic relationships have limited success of most of the programmes. The village chicken production system deserves to be considered on its own merit, where small investments can produce good returns. Also the positive impact of local chicken production on rural household nutritional status is well recognised. It is known that a broody hen that produces 60 eggs and 2-3 slaughter birds per year can provide 4 kg meat per caput which is significantly higher than the annual protein consumption in the rural areas. The predominance of local chickens in the Nigerian poultry industry is a good indicator that these fowls deserve more attention for improved performance (Ikani and Annatte, 2000).

1.3 JUSTIFICATION

Breeding programs for indigenous livestock breeds are lacking in developing countries (Dana, Van der Waaij, Dessie and Van Arendonk, 2010). The indigenous poultry represent valuable resources for livestock development because their extensive genetic diversity allows for rearing of poultry under varied environmental conditions, providing a range of products and functions. Thus great genetic resources embedded in the indigenous poultry await full exploitation that will provide basis for genetic improvement and diversification to produce breeds that are adapted to local conditions for the benefit of farmers in developing countries (Horst, 1988). There is an urgent need to formulate and implement such programs. Developing appropriate

breeding programs for village conditions requires characterization of production circumstances and identification of breeding practices and traits of economic importance to farmers (Abdelqader, Wollny and Gauly, 2007).

1.4 OBJECTIVES

The main objective of the study was to get information on farmers' breeding practices and traits of economic importance towards improving Nigerian indigenous chicken and the specific objectives are to:

1. Identify breeding practices of indigenous chicken farmers in the study area.
2. Assess selection criteria and trait preferences of farmers in the study area.
3. Suggest areas of intervention for genetic improvement of the indigenous chicken populations based on farmer trait preferences.

CHAPTER TWO

LITERATURE REVIEW

2.1 ORIGIN AND DOMESTICATION OF CHICKENS

The domestic chicken *Gallus gallus* is believed to have descended from the wild Indian and Southeast Asian Red Jungle Fowl. The evolutionary history of the domestic fowl can be divided into three phases. The first phase started with the evolution of the genus *Gallus*, followed by the emergence of the domestic fowl from its progenitors and lastly the appearance of the large number of the current breeds, varieties, strains and lines. The domestication of fowl in the region of the Indus valley is believed to have occurred by 2000 BC (Zeuner, 1963) but some archaeological evidences showed that a much earlier domestication occurred in China 6000 BC (West and Zhou, 1989). Four species of *Gallus* have been considered as progenitors of the domesticated fowl: *Gallus gallus* (Red Jungle fowl), *Gallus lafayettei* (Ceylon Jungle fowl), *Gallus sonnerrati* (Grey Jungle fowl) and *Gallus varius* (Green Jungle fowl) and all found in regions of Southeast Asia (Stevens, 1991). The Red Jungle fowl is one of the oldest domesticated birds and its popularity quickly spread to Europe. Its original popularity till the beginning of the 19th century was not for meat but for game of cock fighting and use in religious rituals (Singh, 2000). The utilization of poultry for meat and eggs came into picture during the 20th century when the poultry industry developed as a commercial industry (Crawford, 1990).

The genome of the domestic chicken has a haploid number of 39 chromosomes, eight pairs of macro chromosomes, one pair of sex chromosomes (Z and W) and 30 pairs of micro chromosomes. The size of the chicken genome is estimated to be 1.2 X 109 bp (Olofsson and Bernardi, 1983; Groenen, Cheng, Bumstead, Benkel, Briles, Burke, Burt, Crittenden, Dodgson, Hillel, Lamont, Leon,

Soller, Takahashi and Vignal, 2000). Chickens, like other avian species, differ from mammals in that the female is the heterogametic sex (ZW) and the male is the homogametic sex (ZZ), the Z and W chromosomes displaying heteromorphism (Singh, 2000).

2.2 OVERVIEW OF POULTRY PRODUCTION

The word poultry refers to all domesticated birds that are reared for the production of meat and eggs for human consumption as well as for economic benefits. It includes chickens, turkeys, ducks, geese, quails, guinea fowls and other domesticated birds (Singh, 2000). However, the word poultry is synonymously used with the word chicken. Turkeys and ducks, which at present are rare, were introduced by foreigners (Habtamu, Bereket and Binyman, 2013). There is no recorded information which indicates when and by whom the first batch of exotic breeds of chickens were introduced. It is widely believed that missionaries imported the first exotic breeds. However, over the past few decades, many exotic breeds, including the White Leghorn (WLH), Rhode Island Red (RIR), New Hampshire and Cornish have been introduced into the country by different government and non-governmental organizations and/or institutes. These breeds were kept for egg and meat production and were also used to upgrade the indigenous chickens (Halima, 2007). Despite a number of intensive production systems with modern strains for egg and broiler production, up to 98.5 % and 99.2 % of the national egg and poultry meat production (Halima, 2007) is still obtained from traditional chicken production systems, with an average annual output of 72300 metric tones of meat and 78000 metric tones of eggs (Mekonnen, Michael and Disassa 2016).

2.3 UNDERSTANDING THE LOCAL CHICKENS

Local Chickens are omnivorous, living on seeds, insects, worms, leaves, green grassed and kitchen scraps. The village hen lays a dozen eggs, takes 3 weeks to hatch out a brood of chicks, stays with the chicks six weeks or more, and only then starts laying again. The scavenger hen can begin to lay at about 6 months of age. The average weight of the egg is approximately 40gm. These passive gregarious birds have pronounced social (pecking) order. If acclimatized, they remain on the premises and are unlikely to go feral. If given a little evening meal of "Scratch" they learn to come back home to roost at night (Ikani and Annatte, 2000).

2.4 CHICKEN MANAGEMENT SYSTEMS

The terminology used to describe chickens is confusing, as they are referred to as "indigenous", "native", or "local". According to the Oxford Dictionary, 1990 these terms are defined as;

1. Indigenous: living naturally in an area; not introduced
2. Native: belonging by birth to a specific area, country
3. Local: native inhabitant. Hence, for the purpose of this study it was decided to use the word "indigenous" for the characterization of chickens.

Poultry production is categorized into traditional, small and large-scale orientated sectors, which is based on the objective of the producer, the type of inputs used, and the number and types of chickens kept (Alemu, 1995). The rural poultry sector constitutes about 99 % of the total chicken population and managed under the traditional village poultry production systems. The most recent progress available on chickens indicate that at national level they are raised in small flocks of six birds of varying ages (Hassen, Neser, De Kock and Van Marle-Köster, 2009) under a

traditional scavenging system. They are characteristically an integral part of the farming systems requiring low-inputs, low-output and periodic destruction of a large portion of the flock due to outbreaks of diseases. Major causes of mortality for these chickens are Newcastle disease, Coccidiosis, Salmonellosis, Chronic respiratory disease as well as nutritional deficiencies and predation (Ashenafi, Tadesse, Medhin and Tibbo, 2004).

The main feed resources under this system are the household wastes. Provision of other inputs such as housing, additional feed and health care vary considerably among and within regions depending on the socio-economic circumstances of the farmers (Ashenafi, Tadesse, Medhin and Tibbo, 2004).

2.5 CHOICE OF FOUNDATION STOCK

In judging chickens for use as foundation stocks, the conformation, body size and the correct color of the variety are the most important factors to be taken into consideration. The foundation birds must be free of defects and diseases (Ikani and Annatte, 2000) also when a hen is a poor layer, the body appears smaller than when she is in production. When she starts laying, a considerable development occurs in the ovary and this activity is expressed in the increased size of the comb and wattles. Ikani and Annatte (2000) noted that if the body capacity is small and the space between the pelvic bones is narrow the hen is a poor layer, therefore, the expansion and development of these parts are absolutely essential for good egg laying. Ikani and Annatte (2000) said that good layers must have vigorous head, be alert and have healthy eyes with strong curved beak which a broad and flat back which is an indication of good egg laying also.

Ikani and Annatte (2000) reported that when the best local hen has been carefully chosen, it is important to look out for a good cock of high reproductive

performance. Since one cock is usually mated to about eight hens, a cock's prolific ability is more valuable in the improvement of next generation. The choice should be based on good conformation/body size, free from any defects and disease, should be alert, healthy and vigorous. The combs/wattles have to be bright red and soft. The cock should have strong legs, sharp eyes, be attractive and must have a high sex drive. These qualities are important in order to ensure the best offspring.

2.6 THE PRODUCTION ENVIRONMENT AND MANAGEMENT PRACTICES

Livestock genetic improvement programs should incorporate improvement in the production environment and the traditional management practices. Characterization of the production environment consists of a description of the climatic conditions, feed resources, and prevalence of diseases, input levels, and constraints to increases in productivity. Characterization of the management practices requires describing the community's indigenous coping strategies and management practices. The purpose is to ensure that the environment supports new genotypes resulting from genetic improvement activities (Gizaw *et al*., 2013).

2.7 CHALLENGES AND OPPORTUNITIES OF CHICKEN PRODUCTION

Indigenous chickens provide major opportunities for increased protein production and income for smallholders (Sonaiya, 1997). Chickens have a short generation interval and a high rate of productivity. They can also be transported with ease to different areas and are relatively affordable and consumed by the rural people as compared with other farm animals such as cattle and small ruminants. Chickens also play a complementary role in relation to other crop-livestock activities. Indigenous chickens are good scavengers as well as foragers and have high levels of disease tolerance, possess good maternal qualities and are adapted to harsh conditions and poor quality feeds as compared to the exotic breeds. In some communities, village

chickens are important in breaking the vicious cycle of poverty, malnutrition and disease (Roberts, 1992).

However, lacks of knowledge about poultry production, limitation of feed resources, prevalence of diseases (Newcastle, Coccidiosis, etc) as well as institutional and socio-economic constraints (Habtamu, Bereket and Binyman, 2013; Ashenafi, Tadesse, Medhin and Tibbo, 2004) remain to be the major challenges in village based chicken productions. Adene (1996) had reported that Newcastle disease (ND), Infectious Bursal disease (IBD) or Gumboro, Marek disease (MD), Fowl typhoid, Cholera, Mycoplasmosis and Coccidiosis were the major diseases that have been predominantly identified in commercial poultry in most African countries. Chaheuf, (1990) argued that the most devastating disease in village chickens in Cameroon was Newcastle disease, whereas in commercial poultry, Coccidiosis, Marek disease and Infectious Bursal disease were more prevalent. Research work in Mauritania (Bell, Kane and Le Jan., 1990), Burkina Faso (Bourzat and Saunders, 1990), Benin (Chrysostome, Bell, Demey and Verhulst, 1995) and Tanzania (Yongolo, 1996) supported the argument that Newcastle disease was the most devastating disease threatening village chickens. This forced the owners to sell and purchase chickens with the lowest and highest prices during the beginning of the rainy and dry seasons, respectively. This caused the consumers to have an abundant and scarcity of chicken products during the rainy and dry seasons, respectively.

2.8 PRODUCTION AND PRODUCTIVITY PERFORMANCE OF INDIGENOUS CHICKENS

2.8.1 Growth Performance

Although, the Nigerian indigenous chickens possess small body size and grows slowly, it has been concluded that they reach point of inflection earlier than the

exotic (Nwosu *et al*., 1980). Body size of an individual is determined by its rate of growth (Ibe, 1993). Olawunmi, Salako and Afuwape (2008) found that the Fulani ecotype chicken was bigger in size than the Yoruba ecotype chicken 1.76±0.4 and 0.79±0.21 kg for Fulani and Yoruba ecotypes, respectively. Indigenous male chicken was also bigger in size than their female counterparts 1.5±0.06 kg versus 1.29±0.04 kg, respectively (Ajayi and Agaviezor, 2009). Major genes have been reported to show pronounced effect on the performance of indigenous chicken in the tropics (Ibe, 1992). It has also been reported that the frizzled feathered and naked neck genes conferred better feed conversion on these genotypes when compared to their normal-feathered counterpart (Ajayi, 2010; Gunn, 2008). It has been established that differences existed between these ecotypes from morphological point of view (Olawunmi, Salako and Afuwape, 2008). Crossbreeding indigenous chicken with exotic also improved body weight greatly at 12 weeks (Adebambo, 2005).

Australian Agricultural Consulting and Management Company (1984) reported that local males should reach a live weight of 1.5 kg at 6 months of age and the females should weigh 30 % less. Teketel, (1986) found that the local stocks reached 61 % and 85 % of the body weight of White leghorn (WLH) at 6 months of age and maturity, respectively. The carcass weight of the local and WLH chickens at the age of 6 months was 559 g and 875 g, respectively, indicating that village chicken products are often the source of animal protein for resource poor households (Teketel, 1986).

2.8.2 Egg Production

Regarding the production potential of indigenous birds, studies carried out at Wolita Agricultural Development Unit (Wondmeneh, Van der Waaij, Udo, Tadelle and Van Arendonk, 2015) indicated that the average annual egg production of the indigenous chicken was between 30-60 eggs under village based production

conditions. A study at Asela livestock farm revealed that the average egg production of local birds was 34 eggs/hen/year, with an average egg weight of 38g (Brannang and Pearson, 1990).

Growth rate and egg production under conventional system of rearing in the villages are very low. This is generally due to the insufficient feed supply and problem of diseases and social behavior (Ibe, 1998). Egg production when raised extensively is about 40 eggs/year (Ikeobi, Ozoje, Adebambo, Adenowo and Osinowo, 1996) whereas under improved conditions, egg yields of local birds may be doubled (Nwosu, 1979). The age at sexual maturity ranged between 133-169 days under scavenging condition whereas in cage system, it increases to about 189 days (Gunn, 2008). Adedokun and Sonaiya, (2001) also reported mean age at first egg of 157±3.7, 160±3.8 and 165±3.7, respectively for hens from Derived savannah, Guinea savannah and Rain forest zone of Nigeria. Ibe, (1992) also noted that frizzled and naked neck individuals in the tropical environment attaining earlier maturity than normal-feathering birds. The difference in age of pullet in attainment of sexual maturity was attributed to system of management (Tadelle, Million, Alemu and Peters, 2003) and productive trait (Gunn, 2008). Although, egg weight was higher for the heavy ecotype than the light ecotype chicken (Fayeye, Ayorinde, Ojo and Adesina, 2006; Momoh, Ehiobu and Nwosu, 2007), the latter lays more egg than the former. Adedokun and Sonaiya (2001) in their investigation reported that birds that attained early sexual maturity end egg laying earlier than those birds that sexually mature late. More feed was also utilized in producing a dozen eggs by the indigenous chicken than the crossbred chicken.

2.9 NATURAL INCUBATION

The broody hen chosen for natural incubation should be large (to cover and thus keep more eggs warm), healthy and preferably vaccinated with a good brooding and mothering record (Sonaiya and Swan, 2004). Signs of broodiness are that the hen stops laying, remains sitting on her eggs, ruffles her feathers, spreads her wings and makes a distinctive clucking sound (Sonaiya and Swan, 2004).

Eggs usually become fertile about four days after the rooster has been introduced to the hens. A maximum of 14 to 16 eggs may be brooded in one nest, but hatchability often declines with more than ten eggs, depending on the size of the hen (Sonaiya and Swan, 2004). Feed and water provided in close proximity to the hen will keep her in better condition and reduce embryo damage due to the cooling of the eggs if she has to leave the nest to scavenge for food.

Sonaiya and Swan (2004) reported that hen keeps the eggs at the correct humidity by splashing water on them from her beak; this is a further reason for providing her with easy access to water. In very dry regions, slightly damp soil can be placed under the nesting material to assist the hen in maintaining the correct humidity (between 60 and 80 percent). They also reported that fertile eggs from other birds are best added under the brooding hen between one and four days after the start of brooding. In Bangladesh, it has been reported that local broody hens will even sit on and hatch a second clutch of eggs, often losing considerable weight in the process (especially if insufficient attention is paid to the provision of food and water) (Sonaiya and Swan, 2004).

The incubation period for chicken eggs is 20 to 21 days, after sitting for some days, a broody hen can be given some newly hatched chicks and, if they are accepted, the original eggs can be removed and replaced with more chicks. Thus hens with a

better record of mothering can be better utilized for their abilities. Eggs initially need a very controlled heat input to maintain the optimum temperature of 38°C, because the embryo is microscopic in size. As the embryo grows in size (especially after 18 days), it produces more heat than it requires and may even need cooling (Sonaiya and Swan, 2004). Moisture levels of 60 to 80 percent Relative Humidity (increasing during the incubation period) is important to stop excess moisture loss from the egg contents through the porous egg shell and membranes. Factors to consider for successful natural incubation include the following:

1. Feed and water should be close to the hen.
2. The broody hen should be examined to ensure that she has no external parasites.
3. Any eggs stored for incubation should be kept at a temperature between 12 and 14 °C, at a high humidity of between 75 to 85 percent, and stored for no longer than seven days.
4. Extra fertile eggs introduced under the hen from elsewhere should be introduced at dusk.
5. The eggs should be tested for fertility after one week by holding them up to a bright light (a candling box works best. If there is a dark shape inside the egg (the developing embryo), then it is fertile. A completely clear (translucent) egg is infertile (Sonaiya and Swan, 2004).

Sonaiya and Swan (2004) noted that hatchability of 80 percent (of eggs set) from natural incubation is normal, but a range of 75 to 80 percent is considered satisfactory. Setting of hatchings is best timed so that the chicks to be hatched are two months of age at the onset of major weather changes, such as either the rainy (or dry) season or winter/summer. They also stated a plentiful natural food supply over the

growing period of the chicks will ensure a better chance for their survival. Successful poultry species instinctively lay and incubate their eggs at a time of the year when newly hatched chicks will have a better supply of high protein and energy food provided by the environment, however, seasonal changes in weather patterns are also times of greater disease risk (Tadelle, Million, Alemu and Peters, 2003).

The relatively higher proportion of eggs hatched by the indigenous birds may be attributed to a number of factors such as lighter egg weight, small clutch size, and the presence of higher mortality of indigenous chicks that forced the farmers to restock the lost birds (Tadelle, Million, Alemu and Peters, 2003). In the production cycle of the commercial layer, the hen will begin to lay small eggs and in a matter of few weeks will go to medium size and then to the desired large size eggs. Although egg size can be manipulated using fat levels, protein and enzymes, some other factors such as age and body weight of the hen, yolk weight and nutrient intake can influence egg size (Tadelle, Million, Alemu and Peters, 2003).

2.10 VARIATION IN EGG SIZE

Within several avian species egg size varies significantly (Forbes and Wiebe, 2010), with the largest egg in a population generally being at least 50, and in some cases 100% larger than the smallest (Christians, 2002). Yet the high heritability and repeatability of egg size in a number of species suggests that it is a female characteristic and is relatively inflexible within individuals (Christians, 2002). However, this has only been estimated in a relatively small number of species (Silva, Boersma, Mackay and Strange, 2007) and some birds have been observed to show marked variation in size within their broods (Rafferty, Boersma and Rebstock, 2005; Riehl, 2010). In species with multi-egg clutches, size generally varies with laying order, in patterns that are specific to the physiological and reproductive traits of the

particular species (Williams, 2005). While it has been suggested that physiological and nutritional factors may explain intra-clutch variation in egg size (Hargitai, Torok, Toth, Hegyi, Rosivall, Szigeti and Szollosi, 2005) other explanations suggest that females differentially allocate resources within a clutch, adopting a bet hedging strategy (Crean and Marshall, 2009). Life history theory suggests this is most likely to be adaptive when offspring within a brood predictably differ in their likelihood of survival or future success. In species where eggs hatch asynchronously it has been observed that females may vary in egg size with laying order, to mitigate or reinforce sibling competition in what is known as brood reduction and brood survival (Slagsvold, Sandvik, Rofstad, Lorentsen and Husby, 1984). The critical assumption of this theory is that egg size and the variation of investment of resources within a clutch has ultimate consequences for offspring fitness (Krist, 2011).

2.10.1 Relationship between Egg Size and Hatchability

Asuquo and Okon (1993) studied the effects of age in lay and egg size on fertility and hatchability of eggs. The author's observed that egg size within the intermediate range of 45-56 g would hatch better than small eggs. Senapati, Dask Madal and Chatterjee (1996) reported positive correlation between egg weight and hatchability. A close correlation between egg weight and hatching weight in domestic birds has also been documented (Abiola, 1999). Given the high correlation between egg weight and final body weight, the economic importance of egg weight is apparent (Wilson, 1991). Egg size has been widely studied in the context of life-history theory because it can be highly variable. Some studies have shown that egg size can affect both parental and offspring fitness.

Othman, Amin and Rahman (2014) reported that egg size have effect on hatchability, with the rate of hatchability based on fertile eggs for largest, medium and

smallest sized eggs showing that the largest egg size group had the highest hatchability followed by the medium and smallest egg size groups. They also noted that the differences among hatchability results may have resulted from variations in parent factors, feeding conditions, egg storage conditions and related environmental conditions. Many factors may contribute to the failure of fertile eggs to hatch such as lethal genes, insufficient nutrients in eggs and exposure to conditions that do not meet the needs of the developing embryos (Kingori, 2011).

2.10.2 Relationship between Egg Size and Chick Size

The weight of the newly hatched chick (including yolk sac) averaged 66.0% of the weight of the fresh egg. In poultry the body weight of the chick varied in accordance with the fresh weight of the egg from which it hatched, but the absolute weight variation between chicks increased slightly over variation between eggs. In chicken, yolk size increased relatively more rapidly than body size with increase in egg size (Robert, Ricklefs, Caldwellh, William and Montevecch, 1976).

2.10.3 Relationship between Egg Size and Chick Survival

The survival advantage of chicks from large eggs presumably derives from large body size, large yolk reserves, or both. These characteristics must reflect in turn systematic relationships between the size and contents of freshly laid eggs (Parsons, 1970). It has been shown that egg size can influence fitness through its effect on phenotypic traits. However, it is also important to consider its direct effect on growth and survival. Increased growth rates may improve the likelihood of early survival by reducing the time spent where young is vulnerable to environmental challenges and is optimal prey size for predators (Anderson and Alisauskas, 2002) enabling offspring to make the transition out of the nest quickly and safely.

The positive correlation between egg size and initial nestling growth suggests that egg size may be important in determining the mortality levels that occur shortly after hatching in several species (Williams, 1994). However, despite this assumption direct evidence for a causal relationship between egg size and offspring survival is less consistent (Van de Pol, Bakker, Saaltink and Verhulst, 2006), and has been found in only a handful of studies (Bolton, 1991; Pelayo and Clark, 2003). Yet in an experimental cross-fostering study on American coots (*Fulica Americana*), Reed, Clark and Vleck (2009) found that offsprings hatching from larger, early-laid eggs have higher juvenile survival than those from smaller, later-laid eggs, regardless of their size relative to their siblings. This study seems to provide strong evidence for egg size effects on offspring survival; however, the results could be confounded by the possibility that the foster parent may have plastically adjusted their quality of care to the offspring state determined by egg size (Krist and Remeŝ, 2004).

Furthermore the effect of reduced egg size on chick growth and survival may be important only when the egg significantly deviates from the optimum size (Wagner and Williams, 2007). In a manipulative study, Wagner and Williams (2007) experimentally reduced the egg size of zebra finches (*Taeniopygia guttata*) using the antiestrogen tamoxifen to show that size reductions of 18% can result in lower post-hatching survival, slower rates of initial growth and lower fledging mass, whereas in a previous study on the same species, egg size was reduced by 8% and few effects were observed (Williams, 2000). In criticism of this technique, laboratory manipulation may have directly influenced female condition, rearing abilities and egg composition which may confound results. Although these effects were argued to be negligible in this particular study (Wagner and Williams, 2007), they were unlikely to be absent completely. It has also been suggested that egg mass has a greater influence on

survival in precocial rather than altricial species with periods of extended parental care (Magrath, 1992), although in a recent meta-analysis of egg size effects in birds, Krist (2011) found no evidence for differential effects in species with different modes of development.

2.11 BROODINESS

This is the action or behavioral tendency to sit on a clutch of eggs to incubate them, often requiring the non-expression of many other behaviors including feeding and drinking (Romanov, 2001). Being broody has been defined as being in a state of readiness to brood eggs that is characterized by cessation of laying and by marked changes in behavior and physiology (Romanov, 2001). Broody birds often pluck feathers from their chest and abdomen, using them to cover the eggs. As a consequence of this, they develop one or several patches of bare skin on the ventral surface. These reddish, well-vascularized areas of skin are usually called brood patches, and improve heat transfer to the eggs. Broodiness is usually associated with female birds, although males of some bird species become broody and some non-avian animals also show broodiness.

2.11.1 Broodiness in Local Chicken

The use of broody hens to incubate eggs and to rear chicks is common (Meseret, 2010; Addisu, Zewdu and Hailul, 2013).The profitability of a poultry farm is dependent on the hatchability of the breeding hen and the degree of chick survivability. Thus, information on knowledge of local egg selection practices, practices of egg storage, ways of breaking broodiness, methods of egg fertility testing, incubation practices, rate of hatchability and techniques of chick brooding are of paramount importance in identifying intervention areas used as a baseline information

for improvement programs so as to ensure sustainable improvement and utilization of village poultry (Assefa, 2015).

Broody hens can be recognized by their behavior. They sit firmly over the eggs, and when people approach or try to remove the eggs, threaten the person by erecting their feathers, emitting a characteristic sound like *clo-clo-clo* and will peck aggressively. When broody, hens often temporarily cease eating or reduce their feed consumption (Romanov, 2001).

Letting eggs accumulate in a relatively dark place near the floor often stimulates hens to become broody. Placing artificial eggs into nests also stimulates broodiness. Keeping hens in dark places with warm temperatures and in view of vocalizing orphan chicks can induce broodiness, even in breeds that normally do not go broody (Burrows, and Byerly, 1938). Some environmental conditions stimulate broodiness. In heavy breeds of chickens, warm weather tends to bring about broodiness (Romanov, 2001). Removing eggs each day, out of the sight of the hens, help avoid broodiness not only in domestic poultry but also in some wild species in captivity. This continued egg laying means more eggs are laid than would occur under natural conditions (Pearl, 1912). Poultry farming in battery cages also help to avoid broodiness (Orozco Piñán and Castelló, 1963).

2.12 CONTRIBUTION OF CHICKENS TO RURAL HOUSEHOLD ECONOMY IN DEVELOPING COUNTRIES

Village chickens make substantial contributions to household food security throughout the developing world. Indigenous chicken serve as an investment and source of security for households in addition to their use as sources of meat and eggs for consumption and income (Muchadeyi, Wollny, Eding, Weigend, Makuza and Simianer, 2007). Chicken in general are a means of investment that is important to the

welfare of women and children in traditional, low-input farming systems in the tropics. Besides rural households, these low-input, low-output poultry-husbandry systems are an integral component of the livelihoods of most of peri-urban, and some urban households in most parts of the developing world. A review by Gueye (2000) indicated that an average family flock of five adult chickens (two males and three females) enables women in Central Tanzania to have an additional income equivalent to 10% of the average annual income. In the Niger Delta family, poultry husbandry contributes 35% of the income of household women, which represents about 25% of Nigerian minimum wage and 50% of the per capita income (Alabi, Esobhawan and Aruna, 2006). Experiences in many other developing countries have shown that village poultry can be used as an effective means of empowering women and as a tool for poverty alleviation (Al-Jamaien, 2013).

2.13 INDIGENOUS POULTRY GENETIC RESOURCES

Dispersal of domestic chicken from its putative centers of domestication to different regions with diverse environmental conditions and people of different cultural orientations has contributed to the observed genetic differentiation of chicken populations across the world. Other factors that may have played a role in the genetic differentiation include founder effects and genetic drift. Nearly 80% of the estimated 1.3 billion chickens in Africa comprised of the non-descript indigenous breeds raised by village farmers under extensive systems (Gueye, 1998). In Ethiopia the indigenous breeds contribute more than 90% of the national chicken meat and egg output. Most indigenous birds of the developing countries, except those bred for cock fights, are non- specialized, and are known for their ability to survive on irregular supplies of feed and water, and with no to minimal health care. They form vital and integral parts of a “balanced” farming system in terms of providing outputs matching available

inputs. Studies on some of the indigenous birds from the tropics have shown that they are poor producers of eggs and meat (Mathur, El Hammady and Sharara, 1989). Nevertheless, results from several productivity evaluation of indigenous chicken showed that there were some highly productive indigenous bird populations exhibiting even higher performance levels compared to improved breeds under poor production circumstances (Mathur, El Hammady and Sharara, 1989). Indigenous chickens have a number of adaptive traits and genes such as naked necks, minimum and frizzle feathers, black bones and meat, which have special utility in the hot and humid tropics (Akinleye, Bello, Oyedepo, Eruvbetine and Fanimo 2011). Indigenous chickens are known to be ideal mothers, good sitters, excellent foragers, hardy, and are believed to possess better natural immunity against common poultry diseases (Mathur, El Hammady and Sharara, 1989). A review by Islam and Nishibori (2009) and Nishibori, Shimogiri, Hayashi and Yasua (2005) indicated that in Bangladesh and many other developing countries, the meat and eggs of indigenous chicken was highly preferred for its taste and suitability for special dishes resulting in even higher market prices for these chickens than their exotic counterpart. Despite their importance, indigenous breeds are under threat due to various factors such as changing production systems and indiscriminate cross-breeding (Besbes, 2009) and because of the low level of commercial interest on them. In general, their value remained underestimated and poorly documented compared to the specialized breeds in the western world.

2.14 CHARACTERIZATION AND CONSERVATION OF CHICKEN GENETIC RESOURCES

Characterization is affected by agro-climates, ethnic groups, socio- economic, religious and cultural influences in the nature of the qualitative and quantitative traits variation (Halima, 2007). Ethiopia is gateways of domestic animals migration from

Asia to Africa and it has further impact on the diversity of Ethiopian chickens (Hallima, 2007). According to Addis, Kefyalew and Atnaf (2015), it states that diversified chicken characterization is identifying distinct Animal Genetic Resource /AnGR/ and describing their uniqueness in their environment within specific location and describes any measurable (quantitative trait), adaptable and observable (qualitative) nature of AnGR and evaluate effective population size and evaluates status their risks (Addis, Kefyalew and Atnaf, 2015). Different report stated that indigenous chickens are characterized in different parts of Ethiopia; (Addis, Kefyalew and Atnaf, 2015) at Awassa/Sidamo; Bogale (2008) at Fogera District (based on plumage colors as, white, red, black, grayish, brown, white brownish, black brownish, and red brownish), Fissiha (2009) at Bure (characterized based on their phenotypic variations in terms of plumage color, shank length, comb type and growth performances). Based on location Tadelle, Million, Alemu and Peters (2003) at Tilili, Horro, Chefe, Jarso and Tepi, Halima (2007) at Tilili, Gelila, Debre-Elias, MeloHamusit, Gassay/Farta, Guangua and Mecha and Dana (2011) characterized at Farta, Konso, Mandura, Horro and Sheka. However, only 5 chickens are listed in DADIS (Addis, Kefyalew and Atnaf, 2015) and 10 in DAGR-IS (Dana, Tadelle, Liesbeth and Johan, 2009) including those listed in DAD-IS. This small number represented in the databases indicates that locally adapted populations are still un-documented (Dana, 2011).

The Food and Agriculture Organization (FAO) of the United Nations has proposed an integrated programme for the global management of genetic resources (Project MoDAD, http://www.fao.org/dad) on an international level (Scherf, 1995). In addition, a communication and information system called the Domestic Animal Diversity Information System (DAD-IS) is being developed by FAO, with the main

objective to assist countries by providing extensive searchable databases and guidelines for better characterization, utilization and conservation of animal genetic resources (Halima, 2007). Such programmes are important because the AnGR have been faced to genetic dilution due to exotic germplasm use, changes in production systems, markets preferences, natural catastrophes, unstable policies from public and private sectors and the availability of very limited funds for conservation activities (Rege and Gibson, 2003). It should also include the population size of the animal genetic resources, it's physical description, adaptations, uses, prevalent breeding systems, population trends, predominant production systems, description of the environment in which it is predominantly found, indications of performance levels (meat, growth, reproduction, egg) and the genetic distinctiveness of the animal (Weigend and Romanov, 2002). This provides a basis for distinguishing among different animal genetic resources and for assessing the available diversity (Addis, Kefyalew and Atnaf, 2015). The majority of livestock genetic diversity is found in the developing world where documentation is scarce and risk of extinction is highest and increasing. More particularly, it is estimated that 35 % of mammalian breeds and 63 % of avian breeds are at risk of extinction. These local chickens face genetic erosion which may lead to the loss of valuable genetic variability in specific characteristics of their unique genes and alleles pertinent to their adaptation to particular environments (Romanov, Wezyk, Cywa-Benko and Sakhatsky, 1996). Cryopreservation is an important complementary measure for the conservation of diversity in poultry as in other farm animal species. Some recent papers summarize the state of the art in long-term storage techniques for avian semen (Addis, Kefyalew and Atnaf, 2015). Over the past 50 years, preservation technologies have been developed for mammalian gametes

and embryos, in particular for cattle, which enable to run programs to preserve genetic materials (Rodríguez, Herrero and Baltenweck, 2011).

Therefore characterization, conservation and use of indigenous animal resources under low levels of input in the tropics are usually more productive than is the case with exotic breeds (Halima, 2007).

2.15 MOLECULAR BASIS OF NIGERIAN INDIGENOUS CHICKENS

Nigeria is endowed with varied ecological zones and possesses diverse animal genetic resources of the local breeds. These local breeds contain genes and alleles pertinent to their adaptation to a particular environments and local breeding goals (Romanov, Wezyk, Cywa-Benko and Sakhatsky, 1996). Indigenous chickens in Nigeria are becoming seriously endangered owing to the high rate of genetic erosion resulting from diseases and predation. Attempt must be made so that these adaptive features of the local stocks will not be eroded before they are characterized and conserved. Little has been done on the molecular characterization of the indigenous chicken in Nigeria. Adebambo, Mwacharo and Hannote (2009), found no significant differences in genetic distance of indigenous chicken from three populations (Southwest, Northwest and Northeast ecological zones) of Nigeria. They concluded that these chicken populations exhibited genetic homogeneity resulting from intermixes of germ-plasma in Nigeria as the country allows free flow of human and animals.

Molecular markers have played a leading role in characterization of diversity which provides relatively rapid and cheap assays in the absence of quality phenotypic measures (Toro, Fernandiz and Caballero, 2006). As a result the classification of genetic resources based on geographical location needs to be supported by molecular

data to provide unbiased estimates of genetic diversity (Pimm and Lawton, 1998) for the purpose of genetic resource conservation and utilization

2.16 BREEDING MANAGEMENT

Controlled breeding activities are the basis for designing genetic improvement programs. The primary purpose of characterizing farmers' breeding management practices is to assess the possibility of introducing controlled breeding activities under existing traditional practices. Breeding programme that influence implementation of controlled breeding activities include the size, structure, and ownership patterns of the flocks, and breeding owners and use patterns (Gizaw *et al.*, 2013).

Comparatively, little research and development work has been carried out on village chickens, despite the fact that they are more numerous than commercial chickens. Even though, some research has been done in the area of breed evaluation and supplementary feeding (Brannang and Pearson 1990; Abebe, 1992) these studies were not tangible enough to show the relative effect of genetic and non-genetic factors on the performance of the local chickens (Alemu and Tadelle, 1997). Improving the poultry productivity would improve protein nutrition and could increase the income levels of the rural population. In addition, consumers prefer meat from indigenous chickens, because of its leanness. They also like the multi-coloured plumage of these birds. The productivity of indigenous chickens can be improved by providing appropriate housing, disease control and good nutrition (Ndegwa and Kimani, 1997).

2.17 BREEDING OBJECTIVES

Knowledge of the reasons for keeping animals is a prerequisite for deriving operational breeding goals (Jaitner, Soweb, Secka-Njieb and Demp, 2001). Based on the reasons for keeping chickens, the breeding goals of farmers can be defined. The

breeding goal of farmers is to improve their market value through increased meat production (improved growth rates and conformation). The specific breeding objective traits can be deduced from the farmers selection criteria (Jaitner, Soweb, Secka-Njieb and Demp, 2001).

2.18 GENETIC IMPROVEMENT STRATEGIES

2.18.1 Choice of Breeds

It is important to understand the indigenous genetic improvement strategies of communities, as the success of new breeding strategies depends on the communities preferences. The primary focus in this regard is farmers choice of breeds. Traditional farming communities commonly prefer to keep their own traditional breeds to meet their multiple breeding objectives (Gizaw *et al*., 2013). However, farmers preferences are usually influenced by market forces to adopt cross-breeding. Besides, farmers preferences for breeds are influenced by their perceptions of their breeds and previous genetic improvement projects in the area. Positive evaluation of traditional breeds by their owners creates a favourable ground for introducing selective breeding programs (Gizaw *et al*., 2013).

2.18.2 Farmers Selection Practices

Farmers involved in virtually all forms of agricultural production practiced selection of varying scale and intensity for the traits they considered important under their production environment. Village farmers traditionally attached greater selection emphasis to monogenic qualitative traits, plumage color (white in the Amhara region and red in all the rest) and comb type, next to the only quantitative trait (growth). “Qumena” as a composite trait category mainly deriving from general qualitative characteristics such as conformation is also given an important emphasis. This trait category was described similarly and attributed comparable level of importance in

other species of livestock produced by village farmers (Solomon, 2008). Similarly Muchadeyi, Wollny, Eding, Weigend and Simianer (2009) reported that poultry farmers in Zimbabwe traditionally select compact and mature birds rather than angular and tallish ones as breeding stocks though they attached no emphasis to plumage colour. There were almost no differences in the selection of male and female chickens in terms of both the selection criteria employed and emphasis given to the selection traits under the traditional selection practices (Nigussie, Liesbeth, Van der, Tadelle, Johan and Van, 2010), they also stated that selection practices were limited to trait categories which either influenced market price differentials immediately and directly or observed and/or measured the selection candidate itself, although egg production is the most important function of chickens in all households and it was not considered as a selection criterion. Nigussie *et al.* (2010) considered the trait categories selected in both sexes, which were consistent to those preferred by the local chicken market it seems that market of chickens is the principal factor dictating farmers selection practices. Lack of information on egg production of the selection candidate was a less likely reason for farmers' not including this trait in their selection criteria because even in the absence of recording, it could have been possible to select the best female and male offspring for egg production at least by recalling the laying performance of their parents which should be simple due to the very small flock size owned per family.

2.18.3 Traditional Selection Practices

Selective breeding is a long-standing genetic improvement practice among most communities. Okeno, Kahi and Peters (2011), due to lack of control breeding or record keeping by the chicken farmers due to scavenging nature of production, they selected them at household level using their own indigenous knowledge, experience

and performance history of the chicken. Pullets from parents which produce many eggs per clutch, had big body size, disease resistant, good mothering ability and faster growth rate were selected (Okeno, Kahi and Peters 2011). Selection for cockerels was based on big body size, faster growth rate and disease resistance. Other characteristics such as hatchability, broodiness, egg weight, plumage colour and fighting ability are also part of selection practice (Okeno, Kahi and Peters 2011). It is more feasible to improve the traditional selection practice than introduce a completely novel approach. Selective breeding has been a long-standing practice of farmers (Gizaw *et al*., 2013).

2.18.4 Genetic Improvement Options

The breeding strategies adopted over the last several decades largely focused on importing exotic breeds for cross-breeding. Several efforts have been made to this end since the early 1960s (Tibbo, 2006). These have included importing such exotic breeds. However, these genetic improvement programs produced no significant effects on productivity or on farmers' livelihoods and the national economy at large.

Gizaw *et al*. (2013) identified the major drawback in the livestock cross-breeding programs as lack of a clear and documented breeding and distribution strategy. There has been very little consideration of the needs of the farmers, their perceptions, and indigenous practices. Additionally they have had limited or no participation in the design and implementation of the breeding programs. Further, the breeding programs lacked breeding schemes to sustain cross-breeding at the nucleus centers and at the village level. The distribution of the improved genotypes of these programs was indiscriminate and unplanned, resulting in failure of the breeding programs and threatened to dilute the genetic diversity in the country.

The indigenous livestock and poultry genetic resources have high within-breed genetic variations (Dessie, 2001; Tibbo, 2006; Dana, 2011) and desirable

characteristics. However, there has been little effort to improve the genetic merits of the local livestock and poultry resources using the within- breed genetic variation. The few selective breeding programs initiated by the Institute of Agricultural Research in the 1980s, were limited to the formation of elite nucleus flocks and the programs have since been ended. There was no distribution scheme in place for the improved genotypes in the nucleus centers. Currently, selective breeding as a genetic improvement strategy is gaining momentum. There are breeding programs underway for local chickens. Furthermore, a number of studies have been conducted to design suitable breeding schemes for implementing selective breeding in smallholder farming systems (Wurzinger *et al.,* 2008).

2.19 THE BASIS FOR DESIGNING COMMUNITY-BASED BREEDING

The bases for designing community-based breeding programs are the farmers indigenous breeding strategies and the resultant mode of livestock production where farmers strategies arise from their indigenous knowledge of animal breeding and management. Farmers strategies are expressed in their indigenous breeding and management practices, breeding/production objectives, and marketing strategies. The indigenous strategies of the farmers take into account the production environment, long-standing tradition of livestock production practices, management skills, socio-economic and cultural factors, and the availability of inputs and services (Gizaw *et al*., 2013).

The mode of livestock production practiced by a farming community has a direct bearing on the design of livestock development strategies. Thus, the production system in a target area needs to be characterized and understood in order to design a suitable breeding program. Community-based breeding requires a full description of the existing environment, the current level of productivity, breeding objectives, and

the selection criteria, available indigenous knowledge and breeding practices, and the full participation of the farmers (Sölkner, Nakimbigwe and Valle-Zarate, 1998; Kosgey, Baker, Udo and Van Arendonk, 2006). The approach to designing breeding programs should attempt to fit new breeding strategies into the indigenous breeding strategies of the target farmers, rather than forcing exotic methods and products as is the case with the conventional top–down design of breeding programs.

2.20 BREEDING PROGRAM

Development of any genetic improvement strategy requires description of production environment, identifying the availability of infrastructure, setting appropriate breeding objective, selecting traits to be improved based on their influence on returns and costs to the producer and consideration of stockholders (Zewdu, 2004). Thus, designing a breeding program needs decision on a series of such interacting components (Danesh and Jean, 2011).

2.21 IMPLEMENTING BREEDING PROGRAMS

The breeding plan agreed upon by the communities is the basis for developing community-based breeding programs. Baseline information, including flock structures, husbandry practices, and live weight measurements for all the chickens, should be recorded (Gizaw *et al*., 2013). Breeding selection criteria in all areas must be identified; example, phenotypic appearances, such as comb type, plumage colour, body size, conformation, and libido, (Gizaw *et al*., 2013).

CHAPTER THREE

MATERIALS AND METHODS

3.1 SITES AND SCOPE OF THE STUDY AREA

The survey was conducted in some selected Local Government Areas (LGAs) of Kaduna state. The selected LGAs were Chikun, Kajuru and Kachia, they were selected based on convenience and proximity. The state is situated on longitudes 07° 21' E and latitudes 10° 30' N which are the north of the equator in the Northern Nigeria. It experiences a tropical continental climate with two distinct seasonal climates: wet season (May to October) and dry season (November to April). Mean annual rainfall ranged from 1,016mm to 1,524mm with a temperature of between 21.1^{O}C to 30^{O}C. The state is a Guinea Savannah vegetation zone. It has a land mass area of approximately 48,473.2 square kilometre and has a population of more than 6 million (NPC, 2006), with 23 local government areas (Omotosho, Agele, Balogun and Adefisan, 2013).

3.2 SAMPLING PROCEDURE

A multistage sampling was adopted in this study. Three LGAs in Kaduna State namely Chikun, Kajuru and Kachia were selected and five villages were chosen from each. The locations were selected based on indigenous chicken population. Twenty households from each village were also purposively selected based on population of birds.

3.3 DATA COLLECTION

Before the commencement of the study, a reconnaissance tour was conducted and semi-structured questionnaire was used to improve the questionnaires. The questionnaire was used to obtain information on socio-economic characteristics of

indigenous chicken farmers, their breeding practices, selection criteria and trait preferences and flock size and structure.

3.4 DATA ANALYSIS

Data collected from the three locations were entered and managed using Microsoft Excel (2007). The data were then imported to Statistical Package for Social Science (SPSS, 2007) and analyzed. Cross tabulation procedure was used to calculate the percentage of discrete variables, and chi-square test was used to test for the level of significance of socio-economic characteristics of the respondent, while flock size and structure were presented mainly in the form of descriptive statistics and analysis of variance using the General Linear Model Procedure, based on the following model:

$$Y_{ij} = \mu + L_i + e_{ij}$$

Where:

μ = Overall mean

Y_{ij} = the observed flock structure size

L_i = the effect of the i^{th} location (i = 1...3) and

e_{ij} = the residual error.

Where significant difference existed, means were separated using the Tukey test method.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 RESULTS

4.1.1: Socio-economic Characteristics of Respondents

The socio-economic characteristics of chicken owners in the study area are presented in Table 1.

Age group

The result showed there was significant association ($p<0.05$) between age of respondents and location. Majority (30%) of the respondents belonged to the age range of 21-30 years, followed by ages of 31-40, 41-50, and more than 50 with proportions of 29%, 26%, and 10.3% , respectively. Within the locations, the age group of 41-50 accounted for the highest proportion of respondents (37%), followed by ages of 31-40 (28%), 21-30 (21%) in Chikun, while those aged greater than 50 and less than 20 had a proportions of 9% and 5%, respectively; in Kajuru, ages 21-30 had the highest proportion of 37%, and age category of 31-40 followed with a proportion of 28%, while those aged less than 20 had the least(6%). In Kachia, most of the respondents were within the age brackets of 31-40 (33%) and 21-30 (32%) while those less than 20 years recorded the least (3%).

Gender

There was no statistically significant ($p>0.05$) association between location and gender of the respondent. Majority (53%) of the respondents in this study were males, with respective proportions of 58% and 54% in Kachia and Chikun. However female respondents were more in Kajuru (54%), this was because the respondent were mostly Muslims, and they practice the tradition where the women stayed at home while the men go to work.

Occupation

As shown in the table there was significant difference ($p<0.05$) between respondents occupation and location. The major occupation of respondents in the study area was farming, with an overall proportion of 28%, whereas, students, business, civil servants and housewives accounted for 20%, 19%, 16%, and 16%, respectively, while widows had the least proportion of 1% across the locations.

Educational Background

The result for educational background showed there was significant association ($p<0.05$) between respondents educational background and location. Most of the respondents, had secondary education, accounting for 39% of the total, followed by tertiary education (22%), primary education (16%), Islamic education (10%), adult education (8%) while those that had no any form of education accounted for 5%.The highest number of uneducated respondents was observed in Kachia (10%) while Kajuru and Kachia had the highest numbers of those that had adult education and Islamic education, respectively.

Contact with Extension Agent

There was no statistically significant difference ($p>0.05$) between contact with extension agent and locations of the study area. Extension services to utilize improved agricultural technology for increased livestock production and productivity were not provided to any of the respondents in all the locations.

Table 1: Socio-economic Characteristics of Respondents

Variables	Location				X^2
	CHK n=100	KJR n=100	KCH n=100	TOTAL n=300	
Age					
<20	5(5)	6(6)	3(3)	14(5)	15.033*
21-30	21(21)	37(37)	32(32)	90(30)	
31-40	28(28)	28(28)	33(33)	89(29)	
41-50	37(37)	17(17)	22(22)	76(26)	
>50	9(9)	12(12)	10(10)	31(10)	
Gender					
Male	54(54)	46(46)	58(58)	158(53)	2.995^{NS}
Female	46(46)	54(54)	42(42)	142(47)	
Major Occupation					
Business	11(11)	20(20)	27(27)	58(19)	20.477*
CS	13(13)	18(18)	16(16)	47(16)	
Student	25(25)	22(22)	12(12)	59(20)	
HW	23(23)	12(12)	12(12)	47(16)	
Farmer	26(26)	26(26)	33(33)	85(28)	
Others	2(2)	2(2)	0(0)	4(1)	
Educational Background					
None	3(3)	1(1)	10(10)	14(5)	48.19*
Primary	14(14)	14(14)	19(19)	47(16)	
Secondary	57(57)	37(37)	23(23)	117(39)	
Tertiary	20(20)	22(22)	23(23)	65(22)	
AEDU	6(6)	14(14)	6(6)	26(8)	
IEDU	0(0)	12(12)	19(19)	31(10)	
Extension Visits					
No	100(100)	100(100)	100(100)	300(100)	0.00^{NS}
Yes	0(0)	0(0)	0(0)	0(0)	

CHK = Chikun, KJR = Kajuru, KCH = Kachia, CS = Civil Servant, HW = House Wife, AEDU = Adult Education, IEDU = Islamic Education. Others = Widows and Traders, The figure in parenthesis is the proportion in percent.

4.1.2 Foundation Stock

Information about source of foundation stock is presented in Table 2. Majority (71%) of the respondents purchased the birds used as foundation stock from markets, followed by those who got their own stock through inheritance with a proportion of 21%, those that had their stock by custody (15%), and as gift (2%). One farmer started his stock from eggs hatched artificially. Those respondents that had their foundation stock through custody were more numerous in Kajuru (12%). In Chikun the entire respondents got their foundation stock either by purchase (78%) or by inheritance 22%.

Table 2: Source of Foundation Stock of Indigenous Chickens

Variables	Location			
	CHK n(%)	KJR n(%)	KCH n(%)	TOTAL n(%)
Foundation Stock	n=100	n=100	n=100	n=300
Purchase	78(78)	66(66)	69(69)	213(71)
Inherited	22(22)	18(18)	24(24)	64(21)
Custody	0(0)	12(12)	3(3)	15(5)
Hatched	0(0)	1(1)	0(0)	1(1)
Gift	0(0)	3(3)	4(4)	7(2)

CHK = Chikun, KJR = Kajuru, KCH = Kachia, The figure in parenthesis is the proportion in percent.

4.1.3 Flock Structure

The flock structure in the three locations is presented in Table 3. Chicks had highest representation with a mean of 8.42±0.450, with the highest recorded mean in Kachia (8.60±0.610), and followed by Kajuru (8.49±1.055) and Chikun (8.17±0.581). The means differed significantly ($p<0.05$). Hens had an overall mean of 6.55±0.442 with no significant differences between the locations. The grower chicken had an overall mean of 6.39±0.719, with Chikun having the least value of 5.67±0.608, while Kajuru had the highest (6.84±2.010).The means were considerably ($p<0.05$) different. Cocks had the least flock subclass mean of 3.82±0.319, with Kachia, Kajuru, and Chikun having means of 4.19±0.317,4.00±0.815 3.28±0.319, respectively, that also differed to a large extent ($p<0.05$) .

Comparing the overall means for hens and cocks (6.55±0.442 and 3.82±0.319 respectively), it is seen that the ratio of cock to hen was on the average 1:2.

Table 3: Flock Structure of Indigenous Chickens

Variables	Location			OVERALL
	CHK n(mean ±SE)	KJR n(mean ±SE)	KCH n(mean ±SE)	mean ±SE
Chick	817(8.17±0.581)[c]	849(8.49±1.055)[b]	860(8.06±0.610)[a]	`8.42±0.450
Hen	650(6.50±0.411)	657(6.57±1.183)	659(6.59±0.440)	6.55±0.442
Cock	328(3.28±0.224)[c]	400(4.00±0.875)[b]	419(4.19±0.317)[a]	3.82±0.319
Grower	567(5.67±0.608)[c]	684(6.84±2.010)[a]	666 (6.66±0.493)[b]	6.39±0.719

HK = Chikun, KJR = Kajuru, KCH = Kachia, a,b,c = means with the different superscripts across rows were significantly different ($p<0.05$), SE = Standard Error, n = Number of Chicken.

4.1.4 Breeding Practices and Breeding Methods

Breeding Practices

Table 4 shows the breeding practices in the study area. Only 18% of the respondents had breeding experience in improving their chicken productivity either by crossbreeding (31%) or by inbreeding (69%). The lowest percentage of breeding experience was recorded in Chikun (7%)

Breeding Methods:

A proportion of 31% of the respondent across the locations used cross breeding as a way of improving their flock: by introducing exotic cocks into their flocks, while 69% used inbreeding of indigenous chickens, by borrowing of neighbours cock or taking the hen to be serviced by the neighbours cock, as a method of improvement. In both Kachia and Kajuru, 32% and 68% each of the respondents used cross breeding and inbreeding, respectively, to improve the productivity of their chickens.

Table 4: Breeding Practices of Indigenous Chickens in the Study Area

Variables	Location			
	CHK n(%)	KJR n(%)	KCH n(%)	TOTAL n(%)
Breeding Practice	n=100	n=100	n=100	n=300
No	93(93)	78(78)	75(75)	246(82)
Yes	7(7)	22(22)	25(25)	54(18)
Breeding Methods	n=7	n=22	n=25	n=54
Cross Breeding	2(29)	7(32)	8(32)	17(31)
Inbreeding	5(71)	15(68)	17(68)	37(69)

CHK = Chikun, KJR = Kajuru, KCH = Kachia, The figure in parenthesis is the proportion in percent.

4.1.5 Selection Criteria for Breeding Chickens

Selection Criteria for Male

The selection criteria for breeding males are shown in Table 5. A combination of live weight and plumage color was the most frequently mentioned criterion for selecting breeding cocks, accounting for 89.7% of the total respondents. The other respondents (10.3%) based selection of breeding cocks on the basis of comb type.

Selection Criteria for Female

Majority of the farmers (37%) gave emphasis on egg production performance during selection of replacement hens. A considerable percentage (31%) of the farmers indicated a combination of egg production performance and live weight as the selection criterion, while broodiness performance and plumage colour were also considered by 17% and 15% of the respondents, respectively across the locations. Broodiness performance of the hen was determined the history and size of the hen.

Table 5: Selection Criteria for Breeding Cocks and Hens in the Study Area

Variables	Location			
	CHK n=100	KJR n=100	KCH n=100	TOTAL n=300
MALE				
LW & PC	88(88)	87(87)	94(94)	269(89.7)
Comb Type	12(12)	13(13)	6(6)	31(10.3)
FEMALE				
Plumage Color	11(11)	15(15)	19(19)	45(15)
EPP	50(50)	34(34)	27(27)	111(37)
Broodiness Performance	12(12)	25(25)	15(15)	52(17)
LW& EPP	27(27)	26(26)	39(39)	92(31)

CHK = Chikun, KJR = Kajuru, KCH = Kachia, LW=Live weight EPP = Egg Production Performance, PC = Plumage Colour, The figure in parenthesis is the proportion in percent.

4.1.6 Mating Practice and Methods of Control

Mating System

The status of farmers' mating practice and methods of mating control are presented in Table 6. Most (90%) of the farmers observed natural mating in their flocks, accounting for 93%, 89% and 88% in Chikun, Kachia and Kajuru, respectively. Only 10% of the respondents practiced control mating area across the location, accounting for 12%, 11%, and 7% of the respondents in Kajuru, Kachia, and Chikun, respectively.

Ways of Controlling Mating

Those farmers that controlled mating in their flocks mostly (83%) did so by retaining the best cock and hen based on their selection criteria, while the unselected chickens were consumed or sold. A proportion of 17% controlled mating by culling of chicks of unwanted color at young stage.

Table 6: Mating System and Method of Control of Indigenous Chickens in the Study Area

	Location			
Variables	CHK n(%)	KJR n(%)	KCH n(%)	TOTAL n(%)
Mating System	n=100	n=100	n=100	n=300
No	93(93)	88(88)	89(89)	270(90)
Yes	7(7)	12(12)	11(11)	30(10)
Controlling Mating	n=7	n=12	n=11	n=30
RBCH	7(100)	8(67)	10(91)	25(83)
CYSUC	0(0)	4(33)	1(9)	5(17)

CHK = Chikun, KJR = Kajuru, KCH = Kachia, RBCH = Retaining the Best Cock and Hen, CYUC = Culling at Young Stage Unwanted Color.

4.1.7 Trait Preference

Table 7 shows the trait preferences of the respondents. Live weight was the most preferred (62.6%) trait, followed by egg number (14.3%), plumage colour (11%), broodiness performance (5.6%), while combinations of live weight and brooding performance and live weight and disease resistance accounted for 4.6%, and 1.6%, respectively, across the locations. Preference for plumage colour was evident in Kachia, accounting for 27% of the respondents in the location.

Table 7: Trait Preference of Farmers in the Study Area

Variables	Location			
	CHK (%)	KJR (%)	KCH (%)	TOTAL (%)
Trait	n=100	n=100	n=100	n=300
EPP	13(13)	19(19)	11(11)	43(14.3)
LW	79(79)	60(60)	49(49)	188(62.6)
Plumage Color	1(1)	5(5)	27(27)	33(11.0)
BP	6(6)	6(6)	5(5)	17(5.6)
LW&BP	0(0)	7(7)	7(7)	14(4.6)
LW&DR	1(1)	3(3)	0(0)	5(1.6)

CHK = Chikun, KJR = Kajuru, KCH = Kachia, LW=live weight, EPP=egg production performance, BP = broodiness performance, DR = Disease Resistance.

4.1.8 Egg and Broody Hen Selection Practices

Table 8 shows the egg and broody hen selection practices of farmers in the study area.

Egg Selection

Most (95%) of the respondents did not practice egg selection prior to incubation, while only 5% did so based on egg size. Among the respondents that practice egg selection (43%) each selected for large and medium sized eggs, while 14% preferred small eggs.

Reason for Egg Selection

Majority (43%) of the respondents selected eggs for incubation to obtain large chicks, 36% did so in anticipation of better hatchability, while 21% did so for higher chick survival (this was only observed in Kachia).

Broody Hen Selection

Most (79%) of the farmers did not select broody hen for egg incubation, while 21% had the practice of selecting broody hens. The highest number of farmers that practiced selection for broody hen was observed in Kachia (32%), while the lowest was observed in Chikun (12%).

Criterion for Broody Hen Selection

More than half (53%) of the respondents that practiced broody hen selection used history of broodiness ability (based on previous performance or pedigree history) as selection criterion for broody hen. The other respondents used body size as yardstick for broody hen performance with the belief that large birds lay more eggs and hatch more chicks.

Table 8: Egg and Broody hen Selection Practices in the Study Area

Variables	Location			
	CHK n(%)	KJR n(%)	KCH n(%)	TOTAL n(%)
Egg Selection	n=100	n=100	n=100	n=300
No	95(95)	96(96)	95(95)	286(95)
Yes	5(5)	4(4)	5(5)	14(5)
Size of Egg Selected	n=5	n=4	n=5	n=14
Large	2(40)	2(50)	2(40)	6(43)
Medium	2(40)	1(25)	3(60)	6(43)
Small	1(20)	1(25)	0(0)	2(14)
Reason for Egg Size Selection				
Hatchability	3(60)	2(50)	0(0)	5(36)
Chick Size	2(40)	2(50)	2(40)	6(43)
Chick Survival	0(0)	0(0)	3(60)	3(21)
Broody Hen Selection				
	n=100	n=100	n=100	n=300
No	88(88)	80(80)	68(68)	236(79)
Yes	12(12)	20(20)	32(32)	64(21)
Criterion for Broody Hen Selection				
	n=12	n=20	n=32	n=64
Body size	7(58)	9 (45)	14(43)	30(47)
BAH	5(42)	11(55)	18(47)	34(53)

CHK = Chikun, KJR = Kajuru, KCH = Kachia, BAH = Broodiness Ability History,

4.2 DISCUSSION

4.2.1 Socioeconomic Characteristics in the Study Area

The fact that majority of the respondents in this study were between the ages 21and 30 year agreed with the reports of Ig, (2014) and Addisu, Zewdu and Hailul (2013). This indicates the participation of an active age in raising indigenous chickens in the study area. However, Mekonnen (2007) in Ethiopia found that majority of farmers interviewed were found within 30 and 40 years of age. With regards to gender of respondents, this study has found that more than half of indigenous chicken owners were males. A similar finding was made by Nigussie *et al*. (2010) in Ethiopia. This may reflect the transition of rural poultry keeping where women dominated on most activities of village chicken husbandry system (Dinesh and Jean, 2011) to situation where men dominate. In an earlier study conducted by Mekonnen (2007), it was discovered that the number of male respondents was higher than that of females. On the other hand, Ige (2014) in Nigeria and Addisu, Zewdu and Hailul (2013), in Ethiopia observed in their studies that most of indigenous chicken farmers were females. The former explained that poultry rearing and husbandry is essentially the duty of house wives while their husbands cultivate crop and rear large ruminant animals. Gueye (1998), had established that approximately 80% of the chicken flocks in a number of African countries were owned and largely controlled by women.

The fact that the major occupation of the respondents was farming is understandable since it is the most common activity among the people in the study area. A similar finding was made by Meseret (2010), in Gomma district of Ethiopia which indicated that majority of the respondents were fully involved in arable crop farming activities. However Addisu, Zewdu and Hailul (2013), in North Wollo district of Ethiopia found most of the respondents to be involved in business. On the level of

education of the respondents, this study has shown that those that had secondary school education were the most numerous. Therefore utilization of improved agricultural technology from extension workers for improvement of the chickens would not be difficult. In contrast to this observation Ige (2014) reported a high level of illiteracy among his respondents, while Takele and Oli (2011) and Moreda, Hareppal, Johansson, Sisaye and Sahile (2013) also reported low level of education among farmers. Extension services were almost non-existent and as such, majority of the respondents in this study had no access to information on new management and breeding techniques in indigenous chicken production. Similar observations were made by Ige (2014) in Oyo State, Nigeria who found that only 10.5% of the respondents were reached by extension agents.

4.2.2 Foundation Stock of Indigenous Chickens

Unlike the commercial settings that obtain chickens from specialized breeding companies, smallholder farmers often establish their initial chicken flock from different types of unspecialized sources. This intricate web of flock movement and uncontrolled breeding of free roaming flock has resulted in high phenotypic diversity among indigenous chickens. Most of the respondent in the study area got their foundation stock through purchase from markets, while a reasonable number inherited them. This agreed with the findings of Yakubu, (2010) in Nassarawa State, Nigeria and Moges, Mellesse and Dessie (2010) and Takele and Oli (2011). Sonaiya and Swan (2004) had established that in African countries, foundation stocks are usually started using chickens purchased from the markets as grower, pullets and young cockerels. It is therefore obvious that most farmers had no history of their foundation stock and had to base their selection on phenotypic appraisals.

4.2.3 Flock Structure of Indigenous Chickens in the Study Area

The dominance of chicks, and hens and growers in flocks compared to the number of cocks in this study is in agreement with the reports of Yakubu (2010) and Yusuf, Lategan and Masika, (2014) in Eastern Cape Province of South Africa. In a study, Nigussie *et al*. (2010) observed that a considerable proportion, ranging from 31% to 55% of the farmers interviewed did not own breeding males but shared breeding males with neighbors. The fact that cocks generally yield more cash when sold due to their size may explain why they were the fewest. The average ratio of cock to hen in this study is similar to the ratios reported by Mopate and Lony (1999), Moges, Mellesse and Dessie (2010) and Yusuf, Lategan and Masika (2014).

4.2.4 Breeding Practices of Indigenous Chickens in the Study Area

Only a few of respondents had breeding experience in improving their chicken productivity either by cross breeding or by line breeding. This result is in line with report of Addisu, Zewdu and Hailul (2013) and Meseret (2010) which found that traditional chicken production system is characterized by a lack of systematic breeding practice. Majority of the respondent do not control breeding of their stock as most of them practiced extensive management system. Furthermore, a study conducted in different parts of Ethiopia revealed that village chicken breeding was completely uncontrolled (Nigussie, 2011) and replacement stock produced through natural incubation using broody hens. The few respondents that were involved in breeding of chickens in this study kept them under semi-intensive system and did so either by inbreeding or crossbreeding with exotic cocks. In the latter case the farmers explained that they were fascinated with the sizes of the exotic cocks and so felt the need to cross them with the local hens for better offspring.

4.2.5 Selection Criteria on Breeding and Replacement Males and Females Chickens

Although most of the farmers interviewed kept their flocks under the extensive system of management, all of them practiced selection on breeding and replacement males and females based on live weight, plumage colour, comb type, egg production performance and broodiness performance .In selecting males, farmers generally gave more emphasis to live weight and plumage colour, giving preference to large males. Female chickens were selected based on egg production performance and a combination of egg production performance and body live weight. The farmers preferred heavier hens because they believed that the size of the hen influences the size of her chicks. They also preferred hens that lay more number of eggs, hatched and raised the chicks successfully. For both sexes, the farmers preferred bright plumage colors such as white, red, light brown and multicolored birds, while black color was generally not liked. The practice of selection on breeding and replacement males and females was similarly observed by other investigators. For example, Nigussie *et al*. (2010) in Ethiopia found that farmers in the Amhara and Oromia regions gave the highest emphasis for plumage color while in the Southern region, live weight was the most important selection criterion. Another study conducted in the Rift Valley of Oromia in Ethiopia revealed that 68% of the farmers selected productive hen by its body size, 12% by finger accommodation between the pelvic bones and 20% by pedigree performance (Samson and Endalew, 2010). Okeno, Kahi and Peters (2011) reported that farmers in Kenya did selection of chicken for breeding based on combination of comb type and plumage colour and egg production and broodiness performance.

4.2.6 Mating System and Culling Practice

It has been observed that most of the respondents in the study area practiced uncontrolled natural mating system of their flock, while only a very few of them had a controlled mating system and replacement stock is produced through incubation using broody hens. Similar observations were reported by Nigussie (2011) and Mekonen (2007) in different parts of Ethiopia. The free-range scavenging management system prevailing in most African countries makes mating control difficult and leads to indiscriminate mating of cocks and hens resulting in heterogeneous genotypes with various phenotypes. Usually the most aggressive and dominant cock in the neighbor tends to be sire.

Retaining best indigenous or high yielding exotic cock with locals hens, and culling at young stage chicks of unwanted colour were the major ways of mating control employed by the farmers. Slaughtering, sell and devour of unwanted hens were also means of culling unproductive chicken from the flock in the study area. This agreed with the findings of Addisu, Zewdu and Hailul (2013) as well as Fisseha (2009) who revealed that selling and home consumption were the most common methods of culling unproductive chickens from the flock.

4.2.7 Trait Preferences of Respondents

This study has shown that live weight/body size, egg production, plumage color and mothering ability were the most preferred traits in order of preference by farmers in the area. This agreed with the report of Abdelqader, Wollny and Gauly (2007) which also listed these traits as choice traits of farmers with body size and egg production being the most preferred. Other authors also reported same traits as preferred ones but not in the same order of preference. For example, Addisu, Zewdu and Hailul (2013) indicated number of eggs and plumage colour as the first and

second most preferred traits in North Wollo Zone of Ethiopia, while Okeno, Kahi and Peters (2011) reported that the majority of farmers in Kenya considered egg yield as the most important trait followed by mothering ability and body size. Identification of traits of economic importance is vital in the development of breeding objectives (Vidogbèna *et al.,* 2010). Therefore breeding programs for improving the productivity of indigenous chicken should target these traits and consider the current and future production circumstances (Addisu, Zewdu and Hailul, 2013).

4.2.8 Egg Selection and Broody Hen Selection

According to this survey, majority of the farmers did not practice egg selection prior to incubation by broody hens. However few of them used to select eggs based on size prior to incubation by the hens in anticipation of some gains such as higher hatchability, bigger chicks and her survival rate of chicks. Addisu, Zewdu and Hailul (2013) in North Wollo Zone of Ethiopia observed that 88.5% of respondents allowed hens to brood without engaging in the selection of eggs to be incubated, while 11.8 % selected large eggs prior to breeding in anticipation of bigger chicks.

Although most of the farmers did not practice selection of broody hens, a good number of them considered either the broodiness ability or body size of hens before allowing them to brood. Meseret (2010) and Addisu, Zewdu and Hailul (2013) reported that farmers in Gomma district and North Wollo Zone of Ethiopia have good practices of selecting hens for incubation based on size (large size hens were preferred). In another study in Bure district of Ethiopia, Fisseha (2009) revealed that most of the village chicken owners had a practice of selecting broody hens used for egg incubation purposes based on the hen's past egg incubation performance, body size, thick feather, and size of eggs laid. Irrespective of location, where broody hens were selected based on body size, farmers believed that large birds possess greater

mothering ability in terms of hatchability of eggs and brooding of chicks, while those that based their selection on broodiness ability using either performance history or pedigree history believed the traits were repeatable in the first case or heritable in the second instance.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

This study was carried out with the objective of ascertaining the breeding practice, selection criteria and trait preferences of indigenous chicken farmers under traditional management system, and to identify areas of intervention for genetic improvement. The study was carried out in Chikun, Kajuru and Kachia Local Government Areas of Kaduna using semi-structured questionnaire administered to three hundred respondents, 53% of which were males. Majority (71%) of the farmers interviewed obtained their foundation stock through purchase from markets. Flocks were dominated by chicks (8.42 ± 0.45) followed by hens (6.55 ± 0.442) grower chicken (6.39 ± 0.719) cocks had the least flock subclass mean of 3.82 ± 0.31. Only 18% of the respondents had breeding experience of which 31% and 69% practiced crossbreeding and inbreeding, respectively. Live weight was the most (62.6%) preferred trait, followed by egg number (14.3%). A combination of live weight and plumage color was the most frequently mentioned criterion for selecting breeding cocks, accounting for 89.7% of the respondents, whereas majority (37%) of farmers gave emphasis on egg production performance during selection of replacement hens. Most (90%) farmers observed natural mating in their flocks. Majority (95%) of the respondents did not practice egg selection prior to incubation, while only 5% did so based on egg size. Bulk (79%) of the farmers did not select broody hen for egg incubation, while 21% were engaged in the practice. None of the respondents had access to extension services. There is therefore the need for a planned chicken breeding system which will take into account the existing socio-economic norms,

breeding practices, selection criteria and trait preferences of the farmers in the communities.

5.2 CONCLUSION

Chickens are major among the animals kept by rural people in the study area, mainly for meat as it is a major source of animal protein for the rural people. In all the locations, most of the respondents had no breeding practice and mating was mainly uncontrolled resulting in heterogeneous genotypes of varying phenotypes. Flocks were dominated by chicks and hens in all the locations. A combination of live weight and plumage colour was the most important criterion for selecting breeding cocks while majority of farmers gave emphasis on egg production performance during selection of replacement hens. Live weight and egg production were the most preferred traits by the farmers. The respondent had no access to extension services and none of them was aware of any existing breeding program aimed at improving chicken productivity in the study area. A community based breeding program that would take these findings into account is therefore needed.

5.3 RECOMMENDATIONS

Based on the findings in this study, it is recommended that:

1. Trained extension agents should be available to the communities to guide them on ways of improvement of indigenous chicken production system, breeding techniques and selection strategies.
2. A community based genetic improvement program that would target increased live weight and higher egg production which will take into account the farmer`s breeding practices, selection criteria and trait preferences should be implemented.

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Appendix 1: Sample of Questionnaire.

QUESTIONNAIRE

1. PERSONAL DATA

a) Name of local government area…….

b) Name of village……

c) House number…….

d) Name of respondent……

e) Date of the interview……..

f) Position of respondent in the household.

1. Head [ ] 2. Wife [ ] 3. Member [ ]

g) Age

I. Less than 20 [ ] II. 21-30 [ ] III. 31-40 [ ] IV. 41-50[ ]

V. More than 50 [ ]

h) Gender

1. Male [ ] 2. Female [ ]

i) Occupation

1. Business [ ] 2. Civil servant [ ] 3. Student [ ] 4. House wife[ ]

5. Farmer [ ] 6. Others, specify…….

j) Educational background:

1. None [ ] 2. primary [ ] 3. secondary [ ] 4. tertiary [ ]

5. Adult education [ ] 6. Islamic education [ ]

k. Religion

1. Christian [ ] 2. Muslim [ ] 3. Others, specify…….

l. Marital status

1. Married [ ] 2. Single [ ]

2. FLOCK STRUTURE

a) What is the foundation of your replacement stock?

1. Purchase [ ] 2. Inherited [ ] 3. Custody [ ] 4. Hatched [ ]

5. Others, specify……

b) What is your flock size?

1. Chicks…….……
2. Hen……..……..
3. Cock……..
4. Grower……..……..

c) Ratio of male:female……..

d) State the number of chickens per genotype

1. Normal feather…… 2. Frizzled feather…… 3. Dwarf ……

4. Naked neck…..

3. BREEDING PRACTICE

a) Do you engage in any breeding practice?

1. No [ ] 2. Yes [ ]

If yes

b) If yes, what is the method of Breeding?

1. Using exotic breeds [ ] 2. Improving Indigenous breeds [ ]

c) In what way do you improve indigenous breeds?

1. Cross breeding [ ] 2. Line breeding [ ]
2. Others, specify…….……..

d) What selection criteria do you use for improving indigenous male chicken?

1. Plumage color [ ]

2. Comb type [ ]

3. Others, specify…….

e) What selection criteria do you use for improving indigenous female chicken?

1. Plumage color [ ]

2. Egg production performance [ ]

3. Broodiness performance [ ]

4. Others, specify……..

5. Mating system.

a) Do you engage in any mating system?

1. No [ ] 2. Yes [ ]

b) If yes, how do you control mating?

1. Culling unproductive chicken [ ]

2. Cull at young stage unwanted color [ ]

3. Retaining the best cock and hen [ ]

4. Preventing mating of unwanted cock [ ]

5. TRAIT PREFERENCE

What is your preferred trait?

1. Egg [ ] 2. Meat [ ] 3. Plumage color [ ] 4. Mothering ability [ ]

5. Diseases resistances [ ] 6. Others, specify……..

6. INCUBATION PRACTICE

a) Do you engage in egg selection?

1. No [ ] 2. Yes [ ]

b) If yes, what size of egg do you select?

1. Large [ ] 2. Medium [ ] Small [ ]

c) What is your reason for egg size selection?

1. Hatchability [ ] 2. Chick size [ ] 3. Chick survival [ ]

d) Do you engage in broody hen selection?

1. No [ ] 2. Yes [ ]

e) If yes, on what basis do you select the broody hen?

1. Body size [ ] 2. Broodiness ability history [ ]

6. OTHER GENERAL ISSUES

a) Do you intend to expand poultry production?

1. Yes [ ] 2. No [ ]

b) If yes, to what size? ----------

c) What are your constraints to future poultry breeding endeavors? …….

d) Do you have contact visits by extension agents?

1. Regularly [ ] 2. Periodically [ ] 3. Rarely [ ]

e) What do you think the government should do to improve productivity of chickens in your area? ----------

Appendix 2: List of Tables

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