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Review article

Poultry production systems and its feed resources in Ethiopia: a research review

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ABSTRACT

This study was done with the objective of assessing the current poultry production system, feed resources and provides valuable information for researchers, producers, instructors and policy makers in Ethiopia. The review was done deeply with original research findings of different scholars working on poultry. This study revealed that there are three poultry production systems classified based on the input, flock size, health and bio-security measures (village poultry production, small scale and commercial production systems). The main poultry feed resources in the country are household wastes, cereal grains and their by-products, industrial by products, oil seed cakes and non-conventional feed resources. There is shortage of commercial feed resources and processing meals thought it is expensive. In conclusion, the most common production system practiced in the major farming community is the village production system with irregular supplementation of cereal grains Therefore, investors and government institutions should avail the concentrate feeds with affordable price to improve the production and productivity of poultry in Ethiopia.

1. Introduction

Poultry production as an integral part of livestock production system plays an important socio-economic role in developing countries (Alders, 2004; Kondombo, 2005). According to AACMC (1984) and Alemu and Tadelle (1997), the rural poultry production contributes about 98.5% and 99.2% of the national egg and poultry meat production, respectively with the annual output of 72,300 metric tons of meat and 78,000 metric tons of egg (ILCA, 1993), which is reared and consumed by private and rural communities (Tadelle and Ogle, 1996). However, in Ethiopia, the per capita poultry consumption is the lowest from the world which is 0.4 Kg eggs and 6.20 kg meat annually (FAOSTAT, 2013).

In developing countries, most rural and peri-urban families keep a small flock of free ranging chicken (Branckaert and Gueye, 1999; Riise et al., 2004). Approximately 80% of chicken population in Africa is reared in a free scavenging system (Gueye, 1998). According to Robert et al., (1992) and Sonaiya (2004), smallholder farming families, landless laborers and people with incomes below the poverty line are able to raise chicken with low inputs and harvest the benefits of eggs and meat via scavenging feed resources. In most African countries, the rural chicken population accounts for more than 60% of the total national chicken population (Sonaiya, 1990). According to Delgado et al., (1999), the proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, the major increase being in the developing world.

In Ethiopia, chicken production is both traditional and modern production system in which most widespread and almost every rural family owns chicken, which provide valuable sources of family protein and income (Tadelle et al., 2003). They are owned by the women in the smallholder farms and it is the only sources of income for the rural women. It is cheap to produce, require little investment, used for food and religious celebrations under the smallholder farmers of the country (Tadelle and Ogle, 2001). The total chicken population in the country is estimated to be 50.38 million with the most dominant chicken types 96.9% are indigenous, 0.54% hybrid and 2.56% exotic (CSA, 2013) in which the indigenous were described as variation in body position, color, comb type and productivity (Teketel, 1986; Tadelle and Ogle, 1996; Tadelle et al., 2003; Halima et al., 2007). Hence, the objective of this paper was to review the research findings of current poultry production system and its feed resources and provide valuable information for researchers, producers, instructors and policy makers.

2. Materials and methods

The available research findings regarding poultry production system and its feed resources in Ethiopia were deeply reviewed from their original reports.

3. Poultry production system

Poultry production system in Ethiopia is classified into three based on many criteria: flock size, housing, feed, health, technology and bio-security (Alemu and Tadelle, 1997; Bush, 2006). These are named as village or backyard poultry production system, small scale poultry production system and commercial production system. On the other side, FAO also classifies the production system in to four based on the level of bio-security. Based on the FAO classification, Ethiopia has three poultry production systems: large commercial poultry production system with moderate to high bio-security, small commercial poultry production system with low to minimal bio-security and village or backyard production system with minimal bio-security (Nzietcheung, 2008). According to Alemu (1995), poultry production system in Ethiopia is classified into three based on the input. These are traditional, with low input production system, modern production system with relatively advanced technology; and small scale intensive system with 50 to 500 birds, using exotic birds, improved feeding and health care.

4. Village/backyard chicken production systems

The production system is characterized as including small flocks, with no or minimal inputs, with low outputs and periodic destruction of the flocks by disease. Birds are owned by individual households and are maintained under a scavenging system with little or no inputs for housing, feeding, or health care. Typically, flocks are small in number with each household flock containing birds from each age group with an average of 7-10 mature birds in

each household, consisting 2 to 4 adult hens, a male bird and a number of growers of various ages (Tadelle and Ogle, 1996; Solomon, 2008).

Most of the birds kept under the backyard system belong to indigenous poultry. Rearing of indigenous poultry offers farmers nutritional, socio-cultural and economic benefits (Nzietcheung, 2008). In backyard poultry, women are mainly responsible for rearing poultry. The income earned from poultry keeping is used to buy food and clothes for children. This production system contributes 98.5% and 99.2% of the national egg and poultry meat production (AACMC 1984; Alemu and Tadelle, 1997). Poultry meat and egg offer a quality protein source throughout most of the year and play a role in household food security. The level of consumption and sale of chickens and eggs varies during the year. According to Aklilu et al. (2007), there is an increase in chicken and eggs consumption during the Ethiopian New Year, Christmas and Easter holidays.

5. Modern poultry production system

The modern poultry production system comprises small scale and large scale commercial production system. The small scale production system is usually characterized by medium flock size (50-500) exotic birds, level of feed, water and veterinary services inputs and minimum to low bio-security. The flock size varies from 20 to 1000 and the breed reared that is meat and egg type and layers. Most of the farms are located around Debrezeit and Addis Ababa city and most farms found feed from Alema farms or Genesis (Nzietcheung, 2008).

On the other hand, the large scale poultry production is highly intensive production system that involves, on average, greater or equal to 10,000 birds kept under indoor conditions with a medium to high bio-security level. This system heavily depends on imported exotic breeds that require intensive inputs such as feed, housing, health, and modern management system. It is estimated that this sector accounts for nearly 2% of the national poultry population. This system is characterized by higher level of productivity where poultry production is entirely market-oriented to meet the large poultry demand in major cities. The existence of somehow better bio-security practices has reduced chick mortality rates to merely 5% (Bush, 2006). In Ethiopia, the commercial poultry sector is situated mostly in Debrezeit areas. ELFORA, Alema, and Genesis farms are the major large-scale poultry enterprises in Ethiopia that are located in Debrezeit. ELFORA, the largest enterprise, supplies about 420,000 chickens and over 34 million eggs per annum to the urban markets in the capital (Abebe, 2006; Bush, 2006).

6. Poultry feed resources

The main feed sources for the village chicken in Ethiopia is scavenging including house wastes, cereals and their byproducts, pulses, roots and tubers, oilseeds and shrubs (Tadelle, 1996). The major constraints of poultry production are inadequate availability of feed sources in terms of quality and quantity and high cost of the feed ingredients regardless of the production system and geographical location. According to Solomon (1996), cereal grains production which constituent the poultry feed is very poor. There are shortages of protein and micro-nutrient supplement which are very important ingredients in poultry ration. The lack of fortified poultry feeds in the country leads to raise poultry under scavenging condition which in turn results in low production. The main reason for low productivity of poultry production in Ethiopia is the poor feeding system (Alemu, 1995; Alemu and Tadelle, 1997). According to Fisseha et al., (2010) and Solomon (2008), the majority of chicken in Ethiopia under scavenging system is maintained with little input of housing, health care and scavenging as sole sources of feed.

Feed cost accounts for two-third of the total cost of poultry production for egg and meat (James, 1992; Solomon, 2008). Hence, smallholder farmers and small scale producers from different corners of the country will have limited access to these formulated rations. Though, there are some poultry producers that can purchase formulated feed, its high cost and transportation expenditure make the sector poor in production. In addition, the other problem that makes the sector poor is that, the ingredients and processed feeds vary in nutritive value and there is no regular quality control mechanism in the country. Lack of feed quality legislations and laboratory facilities for chemical analysis also contribute to the poor quality of processed feeds (Solomon, 2008).

At present, feed resources for livestock come mainly from activities directed towards human food production. In the future, they will increasingly be derived from the agro-industrial and agricultural by-products. The development of alternative production systems using locally available feed resources must start with knowledge on the impact of nutritional requirement using new feed resources, which are often rich in sugars and lipids in contrast with the starch rich feeds used in temperate countries (Preston, 1995).

7. Scavenging feed resources base (SFRB)

The feed resource for rural poultry is obtained by scavenging in and around the homesteads and consists of household wastes, anything edible found in the immediate environment, together with a small amount of grain supplements provided by the household. Accordingly, the scavenging feed resources of backyard poultry comprises of seeds, plant materials, worms insects and unidentified materials which are found around the home (Tadelle and Ogle, 1996; Tadelle and Ogle, 2000). Scavenging feed resource is a base for village chicken, which is not constant and depends very much on both the season of the year and the prevailing rainfall (Tadelle and Ogle, 1996; Alemu and Tadelle, 1997). However, SFRB is usually adequate in protein but deficient in energy (Savory, 1989; Cumming, 1992; Tadelle and Ogle, 2001).

Feed deficiency and malnutrition weakened the birds and made them more vulnerable to predators and also increased their susceptibility to disease. During the dry period the birds need to travel longer distances to find food, which also made them more vulnerable to predators and resulted in contact with other flocks, which facilitated the transmission of disease (Solomon, 2008). Roberts et al. (1992), suggested on determining the capacity of the scavenging feed resource base in relation to the village flock biomass; if the village flock biomass is greater than the capacity of the scavenging feed resource base, there will be increased mortality of chicks and other weaker members of the flock.

The chemical composition of crop contents of scavenging local hens was found different with season and altitude with the mean 8.8% CP, 10.2% CF, 7.8% Ash, 0.9% Ca, 0.6% P and 11.99 MJ/kg DM, ME respectively. The protein content of the feed was higher in the rainy season than the dry season (Tadelle and Ogle, 2000). According to Tadelle and Ogle (1996), the protein requirement of laying hens depends on the egg production, maintenance of body, growth, and feather growth. The daily egg production, the size of egg produced and the average live weight of local birds kept under scavenging conditions are lower than that of exotic or commercial breeds. The calculated protein requirement for local hens is around 11 g / day / hen (Tadelle and Ogle, 1996) and assuming a daily DM intake of around 100 g, this implies a CP requirement of around 11 % of the dry matter.

8. Improving the productivity of scavenging feed resources

According to Solomon (2008), there is deliberate supplementation of chicken during harvesting of crops (October to March) though the quantities gradually decrease from June to August in which scavenging is the only sources of feed for back yard poultry. Fikre (2001) also suggested that even if scavenging provides the basal feed, almost all the chicken owners provide supplementary feeds such as wheat, maize and sorghum. These cereal grains are home produced with some owner's purchase from the market. The daily grain offered per bird is variable and appears to be offered only during the time of harvest. The feed offered by almost all rural poultry producers are incomplete, unbalanced and inadequate, although protein rich foodstuffs such as oil seedcakes and atella (local brewery by-products) are available at very low cost.

According to Tadelle (1996), 30% production was attained from local chickens by supplementing 15g maize and 15g noug (*G. abyssinica*) cake/bird/day in the short rainy and dry seasons. Similarly, 28% production was attained with the supplementation of 30g maize/bird/day. Moreover, 20% production was attained with the supplementation of 30g nouge seedcake/ bird/day on the same season. However, non-supplemented local birds under a similar environment produced only about 14% from scavenging only. Under these conditions, supplementation of 30g/head/day of a mixture of equal proportions of maize and noug seed cake increased annual egg production of local hens by about 100%.

On the other hand, in villages around the south-western part of the country, scavenging White Leghorn layers offered 90g/hen/day of a commercial layer ration produced 200 eggs/hen/year indicating a tremendous potential for improvement in the village systems (Solomon, 1997). However, supplementary feeding of local and Rhode Island Red chickens was uneconomical during the main rainy season implying that the scavenging feed resource available during this season would be sufficient to support economical egg production (Negussie, 1999).

9. Commercial poultry feed resources

According to Solomon (2008), the processed poultry feed comprising of mainly cereal grains, cereal grain by-products and oil seedcakes are available from feed mills that are largely concentrated in and around the capital

city of Ethiopia, Addis Ababa. None of the feed mills have pelleting facilities. This is a serious shortcoming especially for efficient broiler production.

10. Cereal grains

According to Pond et al. (1995) in Europe and North America, energy concentrates (<20% CP) used in poultry diets primarily consist of cereals and their by-products, while elsewhere roots and tubers, fruits and their by-products and other ingredients serve as cereal substitutes (Ravindran and Blair, 1991). With regard to cereals, maize is the most common energy feedstuff fed to poultry worldwide (Leeson and Summers, 1997), though substantial amounts of sorghum, wheat, barley, and rice/rice by-products are also used in poultry diets when price and supply allow for their inclusion. The CP content of cereal grains is relatively low which ranges between 8–12% (McDonald et al., 1995; Pond et al., 1995). However, because cereals and other energy supplements constitute 60–70% of poultry diets, they typically supply a nutritionally important amount (25–40%) of the total dietary protein (Lilburn et al., 1991; Ravindran and Blair, 1992). However, in terms of dietary indispensable amino acid requirements of poultry, most cereal grains are moderately low to deficient in lysine, tryptophan, threonine and methionine (Scott et al., 1982; Ravindran and Blair, 1991; Pond et al., 1995). According to McDonald et al. (1995), the value of cereal proteins for promoting growth in young chicks is in the following order: oats>barley>maize>wheat.

11. Wheat by-products

Though their names still vary in certain countries, the main wheat by-products available for animal feeding include wheat bran, wheat shorts, wheat mill-run and wheat screenings (Leeson and Summers, 1997). *Wheat bran* (15% CP) is the coarse outer covering of the wheat kernel and is rich in fiber. Although its amino acid profile is comparable to that seen in whole wheat, it is little used in poultry nutrition, apart from specialized applications (Leeson and Summers, 1997). *Wheat short* is the product that remains after the extraction of the bran, flour and germ. Accordingly, NRC (1994) actually places wheat shorts within a specific category of wheat flour by-products, which contain 15–16% CP and are classified according to their fiber content: wheat middling (7–9.5% fiber); wheat shorts (4–7% fiber) and wheat red dog (<4% fiber), which is the very finest particles of bran, endosperm and germ. *Wheat mill run* is a combination of wheat shorts and wheat bran. *Wheat screenings* are a by-product of the cleaning and grading of wheat that is destined for human consumption (Leeson and Summers, 1997).

12. Oil seedcakes

Oilseed meals are the protein-rich residues remaining after removal of most of the oil from oil-bearing seeds. Oilseeds have one particular characteristic in common in that they are subjected to manufacturing processes (Dale, 1996). As a result, such processes can increase the amount of nutrient variation already inherent in the raw product and can adversely affect the amino acid content/protein quality of the meal (Ravindran and Blair, 1992).

13. Non-conventional feed resources (NCFR)

According to Devendra (1985), non-conventional feed resources (NCFR) are referred as those feeds that have not been traditionally used in animal feeding and or not normally used in commercially produced ration for livestock. The NCFR are described as those that are produced from production and consumption of crops and animals like agro-industrial by products of animals and plants origins which are inexpensively available. They are characterized as the end-products of production and consumption that have not been used, recycled and salvaged, mainly organic, less economic value than their collection, processing and mostly discharged as waste, sources of fermentable carbohydrates, have deleterious effects on animals and not well known about their nature (alkaloids, toxic amino acids, phenolic compounds, tannins, trypsin inhibitors etc) (Devendra, 1985; Agbide, 1993).

14. Conclusion

In Ethiopia, there are huge number of chickens and their production system is classified in to three mainly based on the input, flock size, housing, feeding, health and bio-security. These are the village production system with low input and bio-security, small scale production system with minimum input and bio-security and the commercial production system with high input and bio-security. The most commonly practiced production system is the village poultry production with irregular supplementation of cereal grains. The commercial production system is owned by private producers/investors and government institutions.

The main available poultry feed resources in the country are the household waste, cereal grains and their byproducts, industrial by products, oil seed cakes and non-conventional feed resources. Most of the feed utilized in the country are the cereal grains and household wastes which are poor in quality, whereas, the industrial by products are expensive and have shortage in availability. Therefore, small scale and commercial producers or investors and government organizations should avail quality feed resources with affordable price and enhance the production and productivity of the large chicken population to improve the livelihood of the poor people in the country.

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