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## **The Issue of Feed-Food Competition and Chicken Production for the Demands of Foods of Animal Origin**

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### **ABSTRACT**

This study reviews all attributes of feed-food competition and enforced-demands of foods of animal origin with the aim of delivering synthesized information for beneficiaries. Population, urbanization and rising incomes are expected to double the demands for livestock products in the developing countries. Based on the demands, there has been a rise in the production of livestock products in the world; however, this overall increase isn't occurring in the poorer African countries, rather declining. With increased production of animal products, there will be also increased demands for feeds. Moreover, increased mono-gastric populations and intensive feeding systems with improved genotypes resulted in a greater demand for concentrate feeds. Since, most production cost of poultry is based on concentrated feeds; this sector has been facing a problem of feed-food competition for those non grain self-sufficient countries. Thus, major poultry feed ingredients have been facing market competition with human food demands of poor countries like Ethiopia. To cope up with this feed-food competition, those poor feeds needs to be technically treated to improving nutritional values and moreover, institutional collaborations and support is demanding in order to facilitate for alternative feed utilizations. Use of biotechnology in animal production also improves feed utilization and productivity. Moreover, advanced concept of biotechnology is still to making edible products from outside the animals. It is conclude that responsible institutions should gear their program and responsibility towards to solving a problem of feed-food competition and dependency for importing improved chicken breeds.

**Key words:** Food demands, feed resource, foods of animal origin, feed-food competition, chicken, technology

### **INTRODUCTION**

Human population growth, urbanization and income improvements are causes of increased demands for foods of animal origin in the developing countries (Abdullah *et al.*, 2011; Steinfeld, 2003). It is reviewed that shortages of animal protein availability is a problem in Africa (Mengesha, 2011). Based on this demands, there has been a rise in the production of foods of animal origin, particularly from poultry and pigs in the world. In this regard, FAO (2010) reported that contribution of poultry meat is around 33% of the total global meat production. However, this phenomena is not true for undeveloped countries in Africa, rather declining (FAO, 2011b; Kearney, 2010; Speedy, 2003; Delgado and Narrod, 2002).

Ethiopia has the highest number of livestock populations in Africa (Solomon *et al.*, 2003). Out of which, poultry production plays an important role in rural livelihoods in Ethiopia (Thomas *et al.*, 2009). However, rising demands for these products has led towards high prices

(Ayele and Rich, 2010) of poultry products in a country. Poultry meat and egg production is the most environmentally efficient animal protein production systems (Mengesha, 2011; Van der Sluis, 2007) in the world. However, consumption of animal source food has always been low and declining as a result of the low production and the continuous growing of populations (FAO, 2005; UN, 2005) for sub-Saharan countries. Ethiopia's per capita consumption is declining overtime (FAO, 2005; Solomon *et al.*, 2003). In contrast to this, the average world's meat consumption is doubled during this period (FAO, 2005).

It has been a common experience that with increased production of animal proteins, there is also increased demands for feeds, particularly for ingredients which have high protein and energy values. The contribution of protein and energy source ingredients is more than 90% of all required nutrients for poultry rations. Most ingredients of the poultry feeds are also used for human nutrition (Mengesha, 2011; John and Njenga, 1992) in east Africa that led for competition. These major poultry ingredients have been facing market competition with human food demands in Ethiopia. Similarly, Gura (2008) reported that the competition between food, feed and agro-fuels is expected to aggravate prices of poultry feeds that enforce producers to look for alternative and locally available feed sources.

According to FAO (1995) reports, increment of mono-gastric animal production and the more intensive feeding systems with improved genotypes resulted in relatively greater demand for higher quality concentrate feeds. Moreover, mass production of pigs and poultry needs a larger proportion of the production of feed crops (Madan, 2005). As cereal products are increasingly used as feeds for animals, its share is projected to reach nearly 45-50% by 2050 in the world (FAO, 2003).

Since, feed is the main cost items in any system of poultry production, the beneficiaries of poultry development have been few in undeveloped countries (Reddy and Qudratullah, 1996). However, UNEP (2011) reported that chicken production is among the most energy-efficient sector in the world.

Information gap is clearly seen between issues of feed-food competition and the driving demands of foods of animal origin. Therefore, reviewing the essentials of feed-food competition and poultry production, in relation to producing animal-source foods for the driving demands is a prioritized issue that will help to look for alternative technologies. Moreover, reviewing the experiences of chicken production and its feed resource and thereby delivering summarized and synthesized information for beneficiaries is also another milestone to improve the production of poultry in the country. Based on this outlined background, the Objectives of this paper were:

- Review the attributes and influences of demands for animal-source foods
- Review chicken production scenarios and the feed-food competition
- Avail the essentials of socio-economical limits and opportunities of chicken productions for the beneficiaries

Most of the research findings which focus on attributing factors and influences of demands for animal-source foods, were reviewed. Research findings that were focusing on the social and economical impacts of poultry production were reviewed. Effects of food-feed competitions on chicken production were also reviewed, depicted and sourced. Trends of production, trade and consumption of poultry were reviewed. All available technologies that would improve food-feed competition and alternative food and feed resources were also reviewed. Moreover, the impacts of climate change on poultry production were also reviewed and synthesized.

**Outlined description of the demands of foods of animal origin:** WHO/FAO (2003) reported that the economic development of a country is normally accompanied by improvements in a country's food supply and the gradual elimination of dietary deficiencies. Demands for animal sources foods, in developing countries have been progressively growing (Thornton, 2010). As Neumann and Harris (1999) reported, animal-source foods supply is not only high-quality and readily digestible protein and energy but are also a compact and efficient source of readily available micronutrients. According to Steinfeld (2003) reports, human population, urbanization and incomes improvements are the main causes to increase the demands for food of animal origin.

The overall increase of supply of animal product is restricted to certain countries and regions and is not an event for undeveloped sub-Saharan countries but is in declining phenomena. Speedy (2003) reported that the countries that consumes the least amount of meat per annum are found in sub-Saharan Africa and South Asia. However, as Jabbar *et al.* (2011) reported, rising global demands for animal products may be an offer of opportunities to the animal producers. In satisfying such enforced demands of foods of animal origins, the greatest increase is expected from poultry and pigs, as well as eggs and milk (FAO, 2011a; Speedy, 2003; Delgado and Narrod, 2002).

**Description of the poultry production sectors:** Based on its level of bio-security and birds/products marketed, poultry production sector is classified as industrial, commercial, medium-commercial and village chicken productions systems (Rushton *et al.*, 2004) in the world. Poultry production in developing countries is possibly described as a scavenging system (Kitalyi and Mayer, 1998). Kryger *et al.* (2010) reported also that approximately 80% of rural households in developing countries engage in smallholder poultry production (village systems). In sub-Saharan Africa, 85% of poultry sector is managed under village production systems (Sonaiya and Swan, 2004) and the species of chicken is the largest constituents of poultry population (Gueye, 2003; Yami, 1995) in Africa.

Around 97.82% of chicken production is traditionally managed (FAO, 2009) in Ethiopia. In this case, it is reported that the economy effects of shocks to this village system by HPAI outbreak in Ethiopia are hypothesized to be small. Women and children are the most responsible groups of the households in managing village chickens in Ethiopia (Mengesha *et al.*, 2008a; Mengesha and Tsega, 2011). As Ayele and Rich (2010) reported that few intermediaries are existed in traditional poultry productions. The value chain for the traditional poultry sector isn't as such complex in Ethiopia. Moreover, Ayele and Rich (2010) reported that no public institutions are involved in importing, exporting, production, marketing and processing or in bio-security, particularly for small-scale producers of a country. Although, modern poultry farms are existed, their share of poultry production remains extremely small in Ethiopia (Ayele and Rich, 2010; Thomas *et al.*, 2009).

Annual poultry meat production in Ethiopia is increased by only 0.34%, on average while annual egg production declined by 0.39% (ILRI, 2000). But, Pica-Ciamarra and Otte (2009) reported that poultry has been the fastest growing sector than any animal farming in some other developing countries like for instance India. Of the supply and demand maps for animal-source foods to 2030, the most dramatic change is projected for poultry meat in South Asia (FAO, 2011b).

**Socio-economics of poultry productions:** Food strategies must achieve the consumption of adequate quantities of safe and good quality foods (WHO/FAO, 2003). However, Speedy (2003) reported that wealth is the main determinant of per capita meat consumption. Technology is

favoring the intensification of poultry production in developing countries (Mengesha, 2011), village poultry; still, is a profitable venture that contributing to the poverty alleviation and has no market problems. Moreover, Ayele and Rich (2010) reported from Ethiopia that most consumers are favoring to the traditional forms of chicken over processed products.

Women and children are responsible for caretaking of chicken and they are also beneficiaries in Ethiopia (Mengesha, 2011; Menhgesha *et al.*, 2008b). Chicken population as well as per capita consumption of egg and poultry meat has been declining to the face of population growth in a country. It is well reviewed that livestock production is likely to be increasingly affected by climate change; however, poultry industry has a relative advantage over the others because of its low global warming potential (Mengesha, 2011). However, Thomas *et al.* (2009) and Mengesha *et al.* (2011) reported from Ethiopia that poultry production is much lower than that of the fast-growing of the human population. In this case, Pica-Ciamarra and Otte (2009) advised that a public investment in support of backyard chicken farming development is important to enhancing nutritional status and employment. Moreover, Heft-Neal *et al.* (2008) reported from Thai that large scale industrial poultry production is one of the economy's most important sources of animal-derived food, employment and income.

**Poultry production and food-feed competition:** Global poultry industries have traditionally faced competition for feed ingredients from other animal industries (D'Souza *et al.*, 2007; Hinrichs and Steinfeld, 2007). In this regards, D'Souza *et al.* (2007) reported that the growth of poultry consumption has been creating a huge gap of unavailability of feed grains to sustain poultry meat production. However, Hinrichs and Steinfeld (2007) reported that in the competition for the scarce feed resource, poultry has competitive advantages over other livestock as it has the best feed converters.

Although, poultry production has been the fastest growing sector than any animal farming in some developing countries (FAO, 2011a), its applicability is not achievable for those non grain self-sufficient countries. Moreover, Chadd (2007) reported that the feed versus fuel debate over cereal utilization set to be continuing controversy. John and Njenga (1992) reported from Kenya that commercial poultry production will never be successful in Kenya until a steady supply of main feed ingredients. Substitution of grains in animal feeding systems goes a long way in resolving the food-feed competition. To design for sustainable feed resource utilization, well described information is required.

**Description of poultry feed resources:** The available feed resources in Ethiopia can be divided into two main categories as conventional and non-conventional feed resources. Conventional feed sources are those traditionally used. Whereas, those non conventional once aren't commonly and traditionally used as chicken feeds (Younas and Yaqoob, 2005). However, conventional feed resources in Ethiopia are facing a problem of competition with human foods. Gura (2008) stated also that the recent feed price increment may upset many of the plans to further development of industrial livestock/poultry productions.

Anxiety on the alternative feed sources utilization is very likely to improve prices increments of poultry feeds. Consequently, FAO (2009) reported that smallholders, if not protected, may be among those who will suffer most from price increases in local feed sources. In this regard, Emam and Hassan (2010) reported from Sudan that the feed cost is the main cost item in different poultry-farm types and sizes.

While replacing alternative ingredients, equivalency of nutritional values, costs and side effects on birds should be assessed and considered. Gradual replacement or substitution of one type feeds or ingredients with the other is always advised to the producers that to adapting birds with such new feeds. The target of replacement of ingredients is always not to affecting the performances of birds.

Moreover, the trend of poultry production and the poultry feed source situation analysis is required for a country. Chadd (2007) reported that elevated levels of poultry feed availability will be required to meet feed demands of poultry production. Moreover, Chadd (2008) reported that if animals are part of an integrated farm production system, the overall energy efficiency can be actually increased through better utilization of organic wastes.

**Feed resource scenarios and poultry productions:** Feed is the most important input for poultry production and the availability of low-priced, high-quality feeds is critical for the expansion of the poultry industry and quality (FAO, 2003; Ismoyowati and Sumarmono, 2011). Moreover, Ravindran and Blair (1992) stated that the survival of the poultry industry in most developing countries, in the future will undoubtedly, depend on the ability of poultry industry to compete with humans for the available food supply. Energy market shocks will transmit into the feed market and increase market risk for poultry production (Hinrichs and Steinfeld, 2007). As Hendy *et al.* (1995) suggested the composition of livestock populations and the intensity of feeding systems determine the mix of concentrate feeds required. Thus, increased mono-gastric animal populations and more intensive feeding systems with improved genotypes resulted in relatively greater demand for higher quality concentrate feeds.

Increments in poultry industry have a profound effect on the demands for feed and raw materials. The increasing cost and decreasing supply of traditional feedstuffs are expected to limit the future expansion of poultry production. This situation highlights the urgent need to improved utilization of the wide range of alternative feedstuffs available in these countries. Hendy *et al.* (1995) and Nweze *et al.* (2011) reported that changes in feeding systems will, however, be influenced by the needs to make the best use of resources available that can also lead to significant changes in demand for some feeds. According to John and Njenga (1992) reports, from Kenya that alternative programs must be initiated to encourage local production of main poultry feed ingredients.

There is a severe shortage of cereals and oilseed (cakes) for use in poultry feeds (Reddy and Qudratullah, 1996). Hence, feed-food competition gives rise to looking for alternative feeds and other utilizing techniques to improving the nutritive values of poor ingredients (Reddy and Qudratullah, 1996; Mengesha and Abda, 2010; Mengesha, 2011). Haagsman *et al.* (2009) reported that the energy consumption of mankind is directly or indirectly used for food production, of which a considerable proportion is used for the production of meat.

According to the Rosenzweig *et al.* (1993) reports, the effect of climate change on crop yields is more adverse. Due to climate change there is a consistent reduction of crop productivity, high market prices and malnutrition in Sub-Saharan Africa (Thompson *et al.*, 2010). Chadd (2008) reported also that additional legislation will affects most aspects of the feed sectors. Moreover, Hendy *et al.* (1995) reported that the key factor that affects demands for feed commodities are human populations and incomes. Food-feed competition can be managed by substitution and correct pricing (Yotopoulos, 1987).

According to some reports, feed costs increments have override livestock prices and feed grain demands has been exceeding production. Therefore, utilization of those poor byproducts can be improved by various techniques; for instance solid state complex enzyme fermentation systems.

Most commonly used energy-rich feed stuffs in conventional poultry diet in Asia, Africa and Pacific nations has never been adequate for both human consumption and industrial uses (Reddy and Qudratullah, 1996). Thus, the higher the price of grains fed to animals the lower meat or eggs amount produced. In addition to increasing human population, a grain yield is also adversely affected by global warming that leads to food-feed competitions (Mengesha, 2011).

In this regard, Chadd (2008) reported that the genetic selection emphasis of recent times linked to nutrition, that of feed conversion efficiency and maximal growth potential. To improve the nutritional values of the feed resources of poultry, technology is required.

**The poor feedstuffs of poultry and the improving technologies:** Some local poultry feed sources needs to be technically treated to improving nutritional values. As a result, these feedstuffs could be used as alternative feed source of poultry. Out of various techniques that have been used to improve poor feeds, some additives have nutritional values (e.g., amino acids) and others are without nutritive values (e.g., enzymes). The later group influences the nutritive value of a diet indirectly by improving the palatability of the diet, availability of ingredients, feed conversion and a healthy balance of the digestive tract's micro flora etc.

The availability of feed is the key factor that limits poultry production. A feed problem for poultry production in Ethiopia is not only the prices and availability but also their low quality. Therefore, the need to adapt feed additives that improves poultry feed utilization in the world may be another hot issue. In this regard, Chen *et al.* (1997) reported that the more effective and promising approaches to solve the problem of feed deficiency in poultry is utilization of additives.

Enzymes have several novel applications (Kumar *et al.*, 2011) and some of them play critical role in the metabolic activities. Hence, feed enzyme supplementation has increased but predominantly in pig and poultry diets (Officer, 2000; Marquardt, 2000). Consequently, performances of egg production, egg mass and feed conversion by egg mass and egg dozen were better for those birds fed diets added with enzymes (Broz and Ward, 2007; Costa *et al.*, 2008; Brenes *et al.*, 1993). Although, there's a genetic variation in performances and feed utilization efficiency in chickens (Egena *et al.*, 2012; Ajayi, 2010; Zhang and Aggrey, 2003). Marks (1991) stated that the feed efficiency difference between genetically diverse stocks of chickens is small. Food-feed competition pushes to search for alternative feed ingredients like fibrous feeds as an energy source (D'Souza *et al.*, 2007). Moreover, Hinrichs and Steinfeld (2007) reported that risk-mitigation strategies for capital-intensive poultry production will become increasingly important in order to cope up with market shocks.

**Opportunities of poultry production as a preferred animal-source food:** Livestock production is likely to be increasingly affected by carbon constraints, environmental and animal welfare legislations (Thornton, 2010; Pant, 2011; Seo and Mendelsohn, 2006). However, poultry industry has a relative advantage over others due to its little warming potential (Mengesha, 2011; FAO, 2010; Costa, 2009); whereas, ruminants, are responsible for greenhouse gas emissions (Haagsman *et al.*, 2009). Moreover, ILRI (2006) reported that the genetic diversity of indigenous chicken is much higher than other livestock species which have a good adaptability for climate and

disease. In this regard, the desire for poultry meat and eggs without taboos and the relative ease in establishing poultry as an industry is driving forces at the movement (FAO, 2011c; Daghir, 2009).

According to FAO (2009) reports, chicken is usually the cheapest of all domestic livestock meats, particularly for sub-Saharan African and South Asian countries. Poultry meat and eggs are highly nutritious, cheapest, without taboos and efficient in feed utilization (Mengesha, 2011; Farrell, 2010; FAO, 2010). On the other hand, Costa (2009) reported that red meat industries have been pro-active in addressing environmental concerns. Poultry flocks; however, are also vulnerable to climate change because birds can only tolerate narrow temperature ranges. Although, poultry has relatively less effects, negative impact is still existed on the environment that due to employment of various production systems-intensive systems has less effect.

**Poultry production systems and the environments:** having a lesser impacts on the environment and global warming than free-range production (FAO, 2010), intensive poultry production needs to be intensified to satisfying protein food demands (FAO, 2011c; Hinrichs and Steinfeld, 2007). Moreover, Steinfeld (2003) reported that livestock production and processing will become dominated by integrated large-scale commercial operations. Generally, Mengesha (2011) reported that upcoming animal-source food supply and demands will pose a challenge to the environment.

**Consummation of chicken products and the human health:** Poultry products are preferred by consumers that these products provide foods with high-quality protein and a low level of fat with a desirable fatty acid profiles (FAO, 2010; Costa, 2009). It is well reviewed that there is a positive relationship between the level of income and the consumption of animal products (Mengesha, 2011). ILRI (2000) reported that quality and safety considerations in foods of animal origin provide commercial opportunities for producers, market actors and industry participants of developing-countries. Moreover, Pisulewski (2005) also reported that consuming poultry and fish products has no risk of cancers. Furthermore, FAO (2003) also reported that the by-products of poultry production are of value if managed and recycled; however, if not managed or recycled properly are of concern.

**Chicken production and the institutional supports:** To stimulate the rural economies, a proactive policy is required Steinfeld (2003) on behalf of the private and public sectors of the livestock production. However, there are no specific governance structures that established in Ethiopia for domestic production and marketing (Ayele and Rich, 2010). As to Muchenje *et al.* (2001) reports, poultry systems are bio-economically complex involving several kinds of resources and input/output flows that include crop-livestock components of the farming system.

According to the Adebayo and Adeola (2005) reports from Nigeria, gaps of poultry production need to be filled by the research and extension institutions to boosting egg and meat production. Sustainable cost effective interventions by the stakeholders are necessary to utilize local chicken potentials in Kenya (Njue *et al.*, 2004). Sonaiya and Swan (2004) reported also that research and development institution must examine the social, cultural and technical constraints of family poultry.

According to Muchenje *et al.* (2001) reports; however, the economic importance of poultry is not adequately appreciated by researchers and decision-makers. Kryger *et al.* (2010) reported also that



although poultry production is practiced by rural households, researchers and outsiders feel that its contribution to livelihoods is little nominal value. As Rodic *et al.* (2010) reported, from Syria although poultry is an important sector, it has no institutional support.

Poultry production has been given little attention by the research and development institutions in developing countries (Kryger *et al.*, 2010; Scanes, 2007).

**Biotechnology and production of foods of animal origin:** Biotechnology in animal production has been advancing (FAO, 1991). Montaldo (2006) reported also that biotechnology is used to increase disease resistance, productivity and product quality in the economically important animals. Moreover, Chen (2001) reported that biotechnology will play critical role in the future in improving animal productivity. As to Peric *et al.* (2009) reports, application of alternative growth promoters in nutrition of fattening chickens would be more efficient.

Since, adoption of animal biotechnology will results in a distinct benefits in prosperity, food security, rural development, animal improvement and economic returns to resource-poor farmers (Aboul-Naga and Elbeltagy, 2007; Chen, 2001), Aboul-Naga and Elbeltagy (2007) advised to enhancing animal productivity and the sustainability through research focused applications of animal biotechnologies and their objectives. Advanced concept of biotechnology is still to making edible products from skeletal muscle cells, cultured from stem cells, outside the animal in a bioreactor (Haagsman *et al.*, 2009).

According to some reports, biotechnology has the potential to improve the productivity of animals via increase growth, carcass quality and reproduction, improved nutrition and feed utilization, improved quality and safety of food. However, Aboul-Naga and Elbeltagy (2007) reported that major constraints for applying animal biotechnologies, in near East and North African countries were summarized as: negligible investment in modern animal biotechnology. Thus, Aboul-Naga and Elbeltagy (2007) reported that Adoption of animal biotechnology will resulted in distinct benefits in prosperity, food security, rural development, animal improvement and economic returns to resource-poor farmers.

## CONCLUSION AND RECOMMENDATIONS

Although, livestock is predicted to become the most important agricultural sector in terms of growing and value-added commodity, this sector couldn't satisfy the high demands of foods of animal origin. In some developing countries, chicken production has been the fastest growing sector than any animal farming that to supplying quality protein foods; however, the sector still is facing problems of feed-food competition and dependency for importation of improved breeds.

The advantage of socioeconomics of poultry productions is well documented in terms of family participation, easiness, nutritional values and environmental friendly but, development is lagging behind for sub-Saharan countries. Moreover, a main cost of poultry production is a concentrated feeds; hence, this sector has been facing a problem of feed-food competition, particularly for those non grain self-sufficient countries. Therefore, alternative feed resource should be properly utilized and the poor feeds also be improved by technologies for exclusive utilization.

Some local poultry feed resources needs to be technically treated to improving nutritional values that to be used as an alternative feed source. Therefore, modern technologies such as solid state fermentation complex enzyme systems and others must be increasingly important in order to cope up with market shocks.

To coping up with the two controversial issues of the high demands of the foods of animal origin and feed-food competition, restructured policy is required that regulates institution integrity.

Use of biotechnology in animal production has been advancing that quickly improving productivity and feed utilization. Moreover, advanced concept of biotechnology is still making edible products from skeletal muscle-cells, cultured from stem cells, outside the animals. Therefore, policy makers need to facilitate its applicability in the future.

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