Department of Animal Science

POULTRY PRODUCTION AND FOOD SECURITY IN EAST AFRICA: IMPACT OF PERSONNEL, TECHNOLOGY AND GENETICS

September 2022
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Food security is a significant concern facing much of the world today, and estimates indicate that nearly **one out of ten people are affected by chronic undernutrition**, with the most severe cases being in Africa (Mbuli et al., 2021). The poultry sector in East Africa (particularly in Kenya, Rwanda, Tanzania and Uganda) has been growing rapidly for the past decade driven by increased urbanization and growth of the middle class, a rise in the number of quick service restaurants in urban areas, and a growing demand for animal protein. However, growth of the poultry sector is not uniform among the various countries. For example, Kenya's poultry sector is the most mature among the four East African countries (Vernooji et al., 2018), with the other three countries making significant strides as well. The region has a huge untapped potential to produce enough food for themselves and a surplus for trade if appropriate food production measures are put into place (Levard and Pautrizel, 2014). However, for a regional approach to poultry development to be successful in East Africa, three key issues that must be addressed together include personnel, technology and poultry genetics (Figure 1).

While many smallholder farmers have adequate experience in village chicken management, sustained adoption of improved breeds and advanced agricultural practices/technologies will require increased knowledge and training. Birhanu et al. (2022) reported only 10.6 percent of respondents had received extension or training services in the previous 12 months. This highlights existing gaps in extension and training programs/services that plague the smallholder production level. **Innovative and integrated extension technological approaches** such as videos, mobile phones, peer-to-peer learning and other digital extension systems should be considered possible options to deliver training and advisory services (Naika et al., 2021; Silvestri et al., 2021).

Figure 1. Addressing key issues are critical to solving food security concerns in East Africa.

In addition, there is a serious **lack of training at the vocational level and above** to produce qualified poultry personnel across East Africa. There is a need for better and more specific training and education regarding the poultry sector, particularly in the areas of disease prevention/treatment and antibiotic alternatives in feed manufacturing. This emphasizes the **need for additional trained poultry extension personnel** to assist smallholder farmers and larger, more intensive poultry producers. Currently, most larger farmers and companies must develop their own internal on-the-job training programs to teach poultry-specific knowledge. Trained extension personnel are needed to develop outreach programs and disseminate knowledge and research-based information, develop in-the-field training programs, and inform clientele about regulations and enforcement of sound biosecurity and animal health practices that would significantly help to reduce and manage disease outbreaks. Targeted improvements in specific areas such as day-old chicks, a high-quality and consistent feed supply, animal health initiatives, knowledge transfer and dissemination, and training related to developing, accessing, and maintaining markets would yield a more efficient crop of poultry farmers.

Challenges to Address

First is the **consistent availability and production of high-quality feed at a competitive price**. The governments in the region have made attempts to incentivize the import of feed ingredients into the region, and countries such as Rwanda and Tanzania have developed strategies to increase growth of their poultry sectors, but a consistent supply of quality feed is an ongoing challenge. In addition, the disparity in available land for maize growth and the market price for maize differs significantly between countries in East Africa. This complicates the cross-border trade in maize, oil seed and oil seed cake which is necessary to provide a clear regional approach to feed production and availability. Furthermore, recent emphasis on antibiotic alternatives and a poultry industry shift to more antibiotic-free broiler production to meet consumer demands has changed feed formulations and manufacturing practices. Many naturally available feed additives are now promising antibiotic alternatives including phytogenic groups (marine algae, herbs, spices, plant extracts, organic acids and essential oils), prebiotics, probiotics, enzymes and their derivatives. Antibiotic alternatives have been reported to increase feed intake, stimulate digestion, improve feed efficiency, increase growth performance and reduce the incidence of diseases by modulating the intestinal microbiota and immune system, inhibiting pathogens, and improving intestinal integrity (Ayalew et al., 2022). However, these various modes of action

suggest that there could be symbiotic, antagonistic, synergistic or combative effects between antibiotic alternatives and other feed ingredients that require further investigations.

A **second major issue is the availability of day-old chicks** across the East African region. Kenya trades with Uganda and Uganda trades with Rwanda but there always seems to be a shortage of day-old chicks across East Africa. This fact alone makes it difficult for farmers to manage costs and plan for the future. In addition to shortage of day-old chicks, there is a seasonality in price that further complicates the situation. Finally, **access to markets** is a serious problem. The East African Community (EAC) is a political and economic block, currently comprising the countries of Burundi, Democratic Republic of Congo, Kenya, Rwanda, South Sudan, Tanzania and Uganda. However, even though the EAC is the most advanced regional block in Africa, it still faces many challenges to implementing certain policies collectively (Vernooij et al., 2018).

Other issues to consider

It is predicted that the human population will be approaching 10 billion by 2050, with the population expected to double in Africa from the current figure of 1.2 to more than two billion by 2050 (Thornton et al., 2009). This population growth may further worsen food insecurity fears in the near future. The projected demand for animal-source protein is particularly concerning as it is expected to double in the same period, creating more threats of undernourishment in sub-Saharan Africa (FAO, 2017). In addition, the continuing health and socio-economic impacts of COVID-19 will likely deteriorate the nutritional status of the most vulnerable population groups (Pius et al., 2021). Food insecurity concerns in Africa are partly related to climate change effects, which are influenced by the limited adaptive capacity of the agricultural system. Agriculture across much of sub-Saharan Africa is expected to be among the sectors hardest hit by climate change (Mendelsohn and Massetti, 2017).

Food Security in East Africa

The East African region is among the regions that are **most vulnerable to food insecurity issues** in sub-Saharan Africa. Deteriorating climate conditions such as droughts and floods only exacerbate the vulnerability of the agricultural system in the region (Otieno et al, 2021). East Africa's economies are heavily dependent on small-scale agriculture, with at least two-thirds of all food production in the region coming from smallholder farms of less than 2 hectares (5 acres) with minimal livestock holdings (Salami et al., 2010). Other challenges to attaining food security in the region include low technological capabilities, insignificant economic growth, increasing populations, unstable social and political environments, natural resource constraints, natural disasters, trade imbalances, weather variability and climate shocks, poor food distribution networks within the member countries, and inadequate food trade between the member countries (Omiti et al., 2011; Laibuni et al., 2011). Each of these issues exerts pressure on the others, increasing the hazards and complexity of the food security situation (Lohuruka, 2020).

East African Poultry Sector

Although not well developed, the poultry sector in East African countries has grown from a backyard poultry keeping operation to a more commercial-oriented system (Vernooij et al., 2018). Despite numerous efforts to develop a commercial intensive poultry production system in East Africa, most poultry are still kept by smallholder farmers in less intensive systems, largely

based on indigenous chicken breeds (De Bruyn et al., 2015). As a result, chicken production by these smallholder farmers is an integral part of rural and resource-poor households' livelihoods in sub-Saharan Africa (Birhanu et al., 2022) and accounts for 80 percent of the poultry flock in the region (FAO, 2020). Low productivity of existing local breeds makes genetic interventions the primary strategy to enhance productivity. However, introduction of exotic genetics into smallholder intensive chicken production has not proven competitive in sub-Saharan Africa because of management issues and high costs for feed, veterinary and energy inputs. While many of these countries have access to exotic germplasm, most birds developed for high-input production systems in temperate climates are generally **not well adapted** to the region's low-input poultry management systems and challenging climate. In addition, most sub-Saharan African countries **cannot produce the large quantities of feed grain** needed to support western-style intensive poultry production. More tropically adapted, improved dual-purpose breeds of birds that can thrive under modest management systems may be a better choice.

Dual purpose breeds

The advantages of dual-purpose breeds in modest management systems are the lower levels of inputs they require and the unique products they produce, which provide essential sources of livelihood, food security and nutritional support to millions of resource-poor smallholder farmers. Dual-purpose breeds more readily produce eggs and meat simultaneously (Mueller et al., 2020), have good scavenging ability (Spencer, 2013), and are easily adaptable to diverse agro-ecosystems and easier to manage at the village level (McDougal, 2019). Conventional and non-conventional feedstuffs can be used without affecting their performance, and they have lower protein requirements and are less susceptible to common diseases such as Gumboro, making **dual-purpose breeds more suitable for smallholder farmer production systems**.

However, understanding smallholder farmers' perception of the **acceptance and use of newly introduced agricultural methods and technologies** is an intricate undertaking. Examining these perceptions is challenging because of smallholders' heterogenous constraints, production objectives, livelihood strategies, and access to information and extension services/personnel (Llewellyn and Brown, 2020). In addition, Weersink and Fulton (2020) indicated sustained adoption of a practice involves multiple stages, including initial awareness about the technology, adoption, evaluation and sustained adoption. Factors affecting this adoption were identified as the relative advantages of the method/technology, trialability, and social, cultural, and personal influences. At the smallholder level, higher production and productivity do not always lead to sustainable adoption of improved methods and technologies due to economic, social, and cultural reasons. Furthermore, a higher yield obtained from technology/practice adoption does not always guarantee higher economic and social gains (Michler et al., 2019). Economic feasibility alone is not a sufficient condition for sustained adoption of agricultural production practices, and there is a need to address the social feasibility (the overall acceptance of the practice by the households and the community) as well (Rietveld et al., 2021).

Going Forward

Technological change is often associated with a shift in resource use and management along the value chain, affecting production efficiency and environmental performances (Pelletier et al., 2018). It's important to evaluate the possible positive and negative environmental impacts of adopting introduced breeds. For example, it is well known that livestock genetic diversity is a critical factor in ensuring productivity and adaptability of all livestock breeds, facilitating

resilience to climate change and long-term food security all around the world. In addition, in most tropical countries, the **smallholder production system represents a unique reservoir** of chicken genetic resources. Several indigenous chicken breeds have been reported to possess both superior levels of genetic variation relative to commercial breeds and unique phenotypic traits signifying valuable local adaptations (Pius et al., 2021). Many of these indigenous chicken breeds are adapted to harsh environmental conditions, poor nutritional regimes, challenging climates and various diseases, compared to exotic breeds, which improve their resilience in the difficult and changing ecological terrains of Africa (Okpeku et al., 2019).

There is legitimate widespread concern in developing countries that as a result of the replacement of indigenous chicken ecotypes with high-producing breeds, indiscriminate crossbreeding, high intake and offtake rate of indigenous chickens promoted by their prolific nature, economic drivers, urbanization, weak policies on the protection of animal genetic resources, and changes in the production system, the world continues to **lose valuable and irreplaceable poultry genetic material** (Pius et al., 2021). In addition, concerns about a loss in genetic variability in commercial poultry strains have also been raised following dramatic reductions in the number of commercial poultry breeders and the number of populations under selection which could threaten the industry in the event of a major disease outbreak, particularly in the face of global climate change (Arthur and Albers, 2003).

Something we must not lose sight of is the need for genetic improvement and conservation of indigenous chicken population genetics and the importance these indigenous species play in the lives of the majority of rural people and resource-poor smallholders in most developing countries. In addition, ongoing **climate change will likely put serious pressure on the livestock sector**, and the adaptability of indigenous chicken breeds to low input environments across diverse agro-ecological conditions provides a unique genetic resource that should be utilized to help address the global challenges of food security, as well as the opportunity to understand the mechanism behind their adaptation to climate change (Pius et al., 2021). Future efforts should seek to utilize this vast array of untapped genetic potential represented by the indigenous chicken genome for the betterment of sustainable growth in the poultry industry across East Africa.

Going forward, the goal should not be to replace indigenous breeds with exotic breeds. The goal should be to define how this vital genetic resource represented by indigenous breeds can be best utilized to address global food security challenges and better adapt poultry to global climate change. Efforts should focus on finding the ideal balance between genetic improvement (which will lessen the food insecurity threat) and the genetic diversity of indigenous chicken populations that may hold answers to questions not yet considered. Obtaining food security will require additional extension personnel and training programs, better utilization of technology to reach the numerous smallholder farmers that drive poultry production across East Africa and taking increased advantage of the untapped gene pool offered by the indigenous chicken population. Food security across East Africa may seem a lofty goal, but it can be an achievable one. However, it will require putting all the pieces (personnel, technology and genetics) together in the right amounts and in the correct order.

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