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Review Article

Indigenous Chicken Farming in Kenya: A Minireview of Genetic Resource, Production Systems, Constraints, and Opportunities

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ABSTRACT

As a larger part of the livestock sector, the poultry farming sub-sector plays a vital role in the Kenyan economy by being a source of food, income, raw materials, and employment to many. Indigenous poultry farming is widely practised in rural households with a significant role in their financial stability and livelihoods. Indigenous chicken products are preferred by consumers due to their unique taste, high nutritional value, and organic production. The increased demand could offer an opportunity for the expansion of indigenous chicken farming in Kenya. Indigenous chickens are commonly reared extensively due to their scavenging abilities and resistance to diseases when compared to exotic breeds. Extensive systems of chicken farming face several challenges that limit productivity including diseases, poor husbandry practises, high cost of feeds, and unreliable marketing channels. Thus, the subsistence rearing of indigenous chickens with poor management practices can be characterized by lower production levels and profit margins. Nevertheless, all is not lost as there are promising opportunities to improve the productivity of indigenous chickens. This manuscript aims to describe the production systems and highlight constraints and opportunities for the expansion of indigenous chicken farming in Kenya.

Keywords: constraints, indigenous chicken, Kenya, opportunities, production systems

INTRODUCTION

Kenya is an East-African country with a total land mass of 580, 367 square kilometers and a population of about 47.5 million people (ROK, 2019). The country is classified into several agroecological zones based on the prevailing climatic conditions (Ndegwa & Iiyama, 2011). Agriculture is the core driver of the Kenyan economy, and it has been estimated to contribute directly and indirectly to almost half of the national gross domestic product. It also employs 80% of the total labour force (Alila and Atieno, 2006). As an integral part of the agricultural economy, livestock farming contributes 18 % of the national GDP and is a source of livelihood for many rural households (KIPRA,2016)

Poultry farming is one of the most vibrant livestock subsectors. According to previous reports, 75% of Kenyan rural households keep a certain number of domestic birds. (King'ori et al., 2010; Onono et al., 2017). Indigenous chickens, constitute 80% of the 57.7 million poultry reared in Kenya as well as constituting 71% of all meat and eggs consumed in Kenya (OECD-FAO, 2011; SDL, 2020b). They also serve vital socio-cultural to small-scale farmers in rural areas (Ndegwa et al., 2014). As the human population continues to expand the demand for poultry products is expected to increase to 164.6 thousand metric tonnes by the year 2030 in Kenya (Robinson,2011; Omondi, 2022). To match this growth in demand, poultry production is expected to increase (Carron et al., 2008). Additionally, the growing human population will increase pressure on land for settlement, hence decreasing agricultural land. Poultry farming requires smaller rearing space compared to other livestock species and

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therefore could act as an alternative source of food and livelihood in the prevailing conditions. Table 1 shows an increasing trend in the poultry population in Kenya.

Table 1. Poultry population in Kenya between the years 2010 and 2019 (Adapted from SDL, 2020b).

Year	Broilers	Layers	Indigenous	Others	Total
2010	2,213,750	2,675,571	24,538,906	779,568	30,207,795
2011	2,600,924	2,847,225	26,219,935	684,243	32,352,327
2012	2,847,440	3,076,808	27,967,976	689,283	34,581,507
2013	2,745,188	3,675,425	32,569,198	878,991	39,868,802
2014	4,069,729	3,693,283	33,088,442	890,762	41,742,216
2015	3,117,554	3,716,911	34,666,188	909,841	42,410,494
2016	3,056,747	4,161,289	36,578,441	922,181	44,718,658
2017	3,819,515	4,237,188	40,067,874	943,719	49,068,296
2018	4,534,600	5,261,279	42,791,309	1,089,623	53,676,811
2019	4,878,517	5,460,174	46,096,114	1,240,160	57,674,965

Recently, the demand for indigenous chicken eggs and meat has increased owing to their perceived superior taste and nutritional benefits (Bett et al., 2012). Indigenous chickens in Kenya are genetically diverse with great phenotypic variations (Otecko et al., 2019). They are mostly reared in rural and peri-urban areas under small-scale extensive farming systems characterized by low inputs and low productivity levels (Ochieng et al., 2013). In extensive systems, chickens are left to scavage for feed and little effort is made to improve their productivity through supplementation and disease control (King'ori et al., 2010).

Indigenous chickens are well adapted to the harsh scavenging environment and therefore are most suitable for rearing in the backyard system (Kamau et al., 2018). Rearing indigenous chickens requires less capital investment thus it is economically viable for households with low income. Unfortunately, the rearing of indigenous chickens has been associated with women and youths who are often economically disadvantaged in society (Kingori et al., 2010). Although it is a popular enterprise, indigenous chicken production remains at a subsistence level, hence lowering its profitability (Ochieng et al., 2013). Adoption of new technologies in poultry farming could help to fully exploit the indigenous poultry resource. The commercialisation of indigenous poultry farming could also have the potential of filling the gap in the supply of poultry products. Furthermore, it has the potential to employ youths who are the majority in the Kenyan labour force (KIPPRA, 2016).

Despite the economic and cultural significance of indigenous chickens, their productivity remains low due to factors such as diseases, high cost of feeds, low adoption of modern breeding and nutritional technologies, and unstable markets that lower their profitability (Odula et al., 2010; Magothe et al., 2012; Milkias et al., 2018). Nevertheless, there is potential to improve indigenous chicken production through commercialization and genetic improvement. The current manuscript seeks to describe the status of indigenous chicken production in Kenya and to highlight challenges and opportunities that influence the sub-sector.

THE INDIGENOUS CHICKEN GENETIC RESOURCE

Domestication of chicken is thought to have taken place in Southeast Asia from where it then spread to other parts of the world through human migration. Chickens are believed to have been introduced in Kenya during the migration of communities from North and central Africa (Maina,2000). Additionally, Asiatic chickens were introduced along the Kenyan coast during the Greco-Roman east-coast trade (Maina, 2000; McDonald et al., 2000). The present-day Kenyan indigenous chicken shows great phenotyping variability in terms of feather patterns, body structure, and colour (Ngeno, 2015). The phenotypes are a result of genotypic variation (Falconer, 1989; Ngeno, 2015). The common chicken phenotypes found in Kenya include the naked neck, crested head, frizzled feathered, Kuchi, dwarf, feathered shanks, normal feathered, tailless, and bearded. (Njenga, 2005, Figure 1 (a-f), respectively)

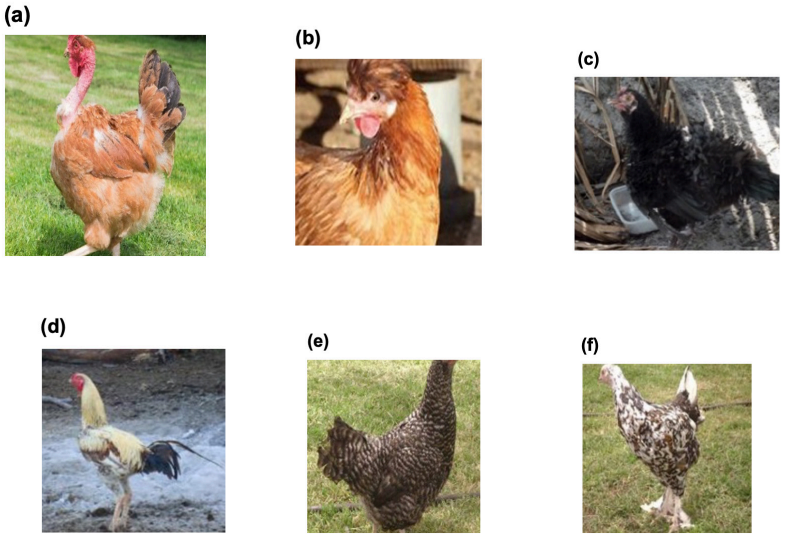

Figure 1. Indigenous chicken phenotypes found in Kenya, (a) Naked neck, (b) Crested head, (c) Frizzled feathered, (d) Kuchi, (e) Dwarf, (f) Feathered shanks. Source: https://infonet-biovision.org/res/res/files. Chicken (new, with animal welfare information) | Infonet Biovision Home. (infonet-biovision.org)

Due to natural and artificial selection, mutation, and genetic drift, indigenous chickens have been said to be highly adaptable to the prevailing ecological conditions in the country (Magothe et al., 2012) As a result, different ecotypes of indigenous chickens with distinguishable morphometric characteristics have been reported (Otecko et al., 2019). In Kenya, these ecotypes derive their names from their geographical locations. As listed by studies on genetic diversity using microsatellite markers (Mwacharo et al., 2007; Mwacharo et al., 2013b), Kenyan indigenous chickens were classified into 10 distinct ecotypes (Kisii, Kitui, Muranga, Marsabit, Meru, Homa bay, Nandi, Kakamega, and Taita. Using MHC- linked markers indigenous poultry were classified into three clusters consisting of birds from different ecotypes (Ngeno et al., 2014). The wide genetic diversity exhibited by indigenous chicken represents a rich genetic resource for the exploitation of potential hybrid vigour for improved productivity in Kenya.

To enhance the productivity of indigenous poultry, improved crossbreeds from various indigenous chicken ecotypes were developed by the defunct Kenya Agricultural Research Institute (KARI) and they are popularly known as *Kienyeji*-KARI. Four improved indigenous chicken breeds namely *Kroiler*, *Rainbow Rooster*, *Kebro,* and *KALRO Naivasha* are accessible to farmers. The improved indigenous chicken breeds are largely dual-purpose with the capacity of producing more eggs and meat compared to the pure-line indigenous chicken (KARI, 2011). Due to their higher growth rate as well as their adaptive capacity, the rearing of improved indigenous chicken has been shown to be more profitable compared to typical indigenous chicken (Njuguna et al., 2017).

The productivity of indigenous chicken has not been adequately assessed which leads to an underestimation of their economic value. According to Chesoo et al., (2021), the production performance of indigenous chicken is highly variable. This is attributed to differences in management practices and genetic potential (Magothe et al., 2012). The indigenous chicken genotypes also show great variability in terms of their productive performance. According to Yeasmin et al., (2003), the dwarf genotype has greater feed efficiency, reproductive performance, and egg production. The bearded and feathered shanks are reported to have higher body weight and egg mass (Fayeye et al., 2006) and perform well in cold areas (Bartel, 2003). The naked neck and frizzle genotypes are reported to have superior body weight performance and improved feed conversion ratio (Magothe et al., 2010). The crested neck chicken has better egg production performance.

INDIGENOUS CHICKENS PRODUCTION SYSTEMS

Generally, poultry production systems in Kenya are classified based on production objectives, prevailing husbandry practices, and level of inputs and outputs (Kitalyi, 1998; Menge et al., 2005; Magothe et al., 2012). Three main production systems have therefore been identified including extensive (free-range), semi-intensive and intensive or commercial (FAO, 2018). Previous studies indicate that 80% of indigenous chickens are raised under the extensive,12% in the semi-intensive, and 8% under the intensive system of production (Okeno, 2012; Ochieng et al., 2013).

The extensive production system is characterised by low input and output levels. It involves the keeping of small flocks of around 23 birds that are left to scavenge freely for feed with little or no supplementation (Ochieng et al., 2013). Indigenous chickens in Kenya are mostly reared in rural areas under the free-range system because it is cheap and less labour-intensive (Kingori et al., 2010). Indigenous chickens are hardy and well-adapted to survive under scavenging conditions. This production system is mainly subsistence oriented with low adoption of modern technology, and informal marketing of products (FAO, 2018). Farmers practising free-range poultry rearing frequently encounter losses from diseases and predation. The dwindling land size due to the rapid human population growth is also likely to hinder extensive chicken farming hence the need for intensive production systems (Magothe et al., 2012).

The semi-intensive production system is characterised by the rearing of improved chicken breeds under advanced management practices. It involves the keeping of larger flocks of around 30 up to 100 birds are kept confined in simple barns and supplemented with homemade or commercial feeds. Phenotyping selection for preferred breeds which are mostly indigenous types is commonly practised (Ndegwa et al., 2015). This production system is commercial-oriented and majorly practised in peri-urban areas. Marketing of poultry products is done through informal traders and middlemen or sold to other farmers and neighbours (McCarron et al., 2015). Disease management is practised to some extent through vaccination and treatment of sick birds through conventional and ethnoveterinary interventions. However, higher incidences of disease prevalence and mortality are still encountered by farmers (Young et al., 2013). The rising demand for poultry meat mainly in urban areas offers an opportunity for further development of this system of production.

In the intensive system of production, exotic birds are raised under highly advanced and stringent biosecurity practices. It is a capital-intensive system of production that is mainly practised in urban and peri-urban areas where the market is readily available (Menge et al., 2005). The system is further divided into layers and broiler production systems. Flock sizes vary depending on the scale of production; 50-500(small scale),500-10 000 (medium) to over 10 000 (large and integrated farms). Day-old chicks are purchased from local hatcheries and a few from neighbouring countries. Birds are fed on commercial feeds and feed additives such as probiotics, vitamins, and mineral premixes are incorporated into the diet. Biosecurity and disease control via vaccination is strictly followed per the directory of veterinary services recommendations (FAO, 2018). Poultry products are marketed in restaurants and retailers and wholesalers. Integrated production systems by well-established companies could also export some poultry products to neighbouring countries like Uganda and Tanzania.

Table 2 summarizes performance parameters that have been reported with the varying production systems. The average age at maturity (age at first laying) has been reported to be 5 months (Okeno et al., 2012). Indigenous hens lay an average of three egg clutches per year each with an average of 16 eggs (Atela et al., 2016). Kamau et al., (2018) reported an average egg weight of 46.5 g. A study to evaluate the growth and feeding characteristics of indigenous chicken ecotypes did not reveal any significant difference in daily weight gain between the various ecotypes (Chesoo et al., 2021). The Homa bay ecotype showed the highest daily weight gain of around 17.60±24g. The mature weight of indigenous chickens has been estimated at 2.22 kg for cocks and 1.58 kg for hens (Okeno et al., 2012). Okeno et al., (2012) reported an average chick survivability of 68%. The performance of indigenous chicken has been shown to improve with the adoption of good management practices (Okeno et al., 2012, Kamau et al.,2018). This implies that the commercialization of indigenous chicken production is a viable venture. However, more research is needed to evaluate the performance of indigenous chickens under different levels of management.

Table 2. A summary of the production performance of indigenous chicken in Kenya

Trait	Intensive	Semi-intensive	Free range	Reference
Age at first laying (months)	5.33	5.65	5.76	Okeno et al., 2012; Atela et al., 2016
Number of clutches / years	3.00	2.99	2.88	Okeno et al., 2012; Atela et al., 2016; Kamau. et al., 2018
Number of eggs / clutches	14.82	16.76	16.56	Okeno et al., 2012; Atela et al., 2016
Egg weight (g)	-	-	46.5	Kamau et al., 2018
Eggs hatched/incubation	10.78	10.33	9.46	Atela et al., 2016
Survivability (%)	-	69.86	67.55	Kamau et al., 2018
Mature weight of cocks (kgs)	-	-	2.22	Okeno et al., 2012
Mature weight of hens (kgs)	-	-	1.58	Okeno et al., 2012
Average daily gain (g)	17.60 ±2.24	-	-	Chesoo et al., 2021

THE INDIGENOUS CHICKEN VALUE CHAIN

The main products derived from indigenous chicken include live chickens, meat, and eggs. Others may include manure, feathers, bones, and shells (ROK, 2013). The Indigenous chicken value chain in Kenya consists of five main role players categorized as input suppliers, producers, output traders, service providers, and consumers (Omondi, 2022). Figure 2 summarizes the indigenous chicken value chain in Kenya.

Poultry inputs supplied to farmers include feed, day-old chicks, vaccines, and drugs. Feed is acquired from both large and small-scale suppliers. Day-old chicks are purchased from small-scale hatcheries or imported from neighbouring countries. The role players at the production level include individual farmers, farmers groups, and small-scale poultry institutions. Chicken farmers have been classified into small, medium, and large scales based on the scale of production. Indigenous chicken farming is predominantly small scaled and less specialized (Omondi., 2020). Earlier research showed that women are more involved in husbandry practices in the free range of production while men predominate in the intensive system of production (Ngeno et al., 2011)

Service providers in the poultry value chain include veterinarians, extension service providers, livestock officers, financial service providers, and non-governmental organisations. Services provided include training of farmers and provision of inputs such as drugs. Poultry farmers obtain advice and veterinary services from private practitioners and government officers. Financial service providers include banks, cooperatives, and farmers' groups. A survey done in 2016 indicates that only a few farmers have access to credit facilities (Omondi ., 2019). There are several available constraints and opportunities for the indigenous chicken value chain; a broader discussion of these factors hereby follows.

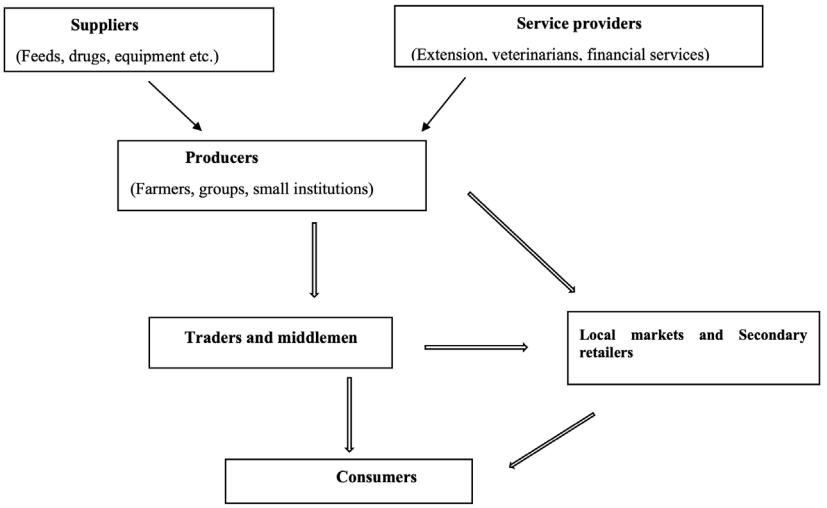

Figure 2. Indigenous chicken value chain.

CONSTRAINTS TO INDIGENOUS CHICKEN PRODUCTION

The exploitation of indigenous chicken resources has not been fully achieved due to a myriad of challenges that hinder production. The production constraints have been extensively investigated and classified into production, socio-economic as well as technical and infrastructural challenges (Mutua, 2018).

1. Production constraints

Diseases

Poultry diseases are reported to be the greatest impediment to successful indigenous poultry farming in Kenya. Some commonly reported diseases could include Newcastle, fowl typhoid, fowl pox, Gumboro, Marek's, and coccidiosis (Omondi, 2018). Disease infection causes great economic losses through mortality and reduced profit margins (Njagi et al., 2012). The disease prevalence could be attributed to low adherence to strict biosecurity measures and lack of strict vaccination schedules in the free-range system of production which is commonly practised.

Poor husbandry practices

Poor housing exposes chickens to predators, theft, and extreme weather conditions. Chickens reared under the free-range system are not adequately housed resulting in losses. Indigenous chickens are often left to scavenge for feed with inadequate supplementation. Poor nutrition results in poor productivity which translates to low profitability. High-quality feeds are often unreachable to ordinary farmers due to high prices. A study by Olwande et al., (2015) revealed that indigenous chickens are often confined in poorly constructed houses which exposes them to diseases and predators. The lack of proper breeding strategies has hampered the improvement of indigenous chicken breeds. Low body weights, slow growth rate, small egg size and a small number of eggs laid downgrade the productivity of indigenous chickens.

2. Socio-economic constraints

Marketing and credit access constraints

A successful poultry enterprise requires a well-organised marketing system. Small-scale farmers lack access to well-regulated marketing facilities. Poultry products are mainly sold to middlemen and brokers who take advantage of the unregulated market to exploit farmers (Danda et al., 2008). Previous reports indicate that most farmers have no access to poultry marketing information. Unpredictable market trends and low market prices also limit the profitability of poultry farming. The marketing of chicken products is largely informal and unpredictable (Magothe et al., 2012). Ayieko et al., (2014) defined several marketing channels for indigenous chickens in Kenya. These channels have common actors including farmers, traders, processors, and final consumers (Nyaga et al., 2007). Indigenous chicken farmers mainly market their produce through brokers and traders or sell directly to neighbours. Some farmers sell their chickens in local markets while brokers and secondary retailers buy eggs and live chickens from farms and then sell them in urban markets where most customers are located.

Due to the small scale of production, most farmers have limited access to financial and credit services. Lack of financial facilitation hinders the expansion of indigenous poultry enterprises. Some of the hindrances to credit acquisition include lack of information, high loan interest, unavailability of banking facilities in rural areas, and low literacy levels among farmers (Wagacha, 2020).

Socio-Cultural barriers

In some cultures, chickens are less valued and often considered women's and children's property hence less investment in chicken farming. The nomadic lifestyle among the pastoral communities makes it difficult to rear chickens (Ndathi et al., 2012). Other reported challenges include land shortage, the high cost of construction materials, and conflicts with neighbours (Kyule et al., 2015).

3. Infrastructural and technical constraints

Physical infrastructure such as roads, communication technology, slaughterhouses, and storage facilities are crucial in any agricultural enterprise. Indigenous chicken farmers especially in rural areas lack access to good roads, water supply, communication, and markets which limits production (Mutua, 2018). The supply of input products such as feeds, drugs, and credit facilities are often not accessible to farmers in the remote parts of the country.

There could also be some technical challenges with studies indicating that most farmers have limited access to training on poultry farming techniques (Mwiti et al., 2021). This has limited the adoption of modern management technologies, hence limiting productivity. Veterinary and extension services are also not readily available to farmers in some parts of the country (Mutua, 2018). Facilities for marketing and value addition of poultry products are also limited.

OPPORTUNITIES IN THE INDIGENOUS CHICKEN PRODUCTION

The rise in human population, changes in consumption trends, rise in incomes, and urbanisation are reported to be the key drivers of the increased demand for animal protein in the developing world (Ndenga et al., 2018). Indigenous chickens serve as a repository for economically important genes (Pius et al., 2021). Their genetic and morphological adaptation allows them to resist diseases and adapt to harsh environmental conditions (Gheyas et al., 2021). These features make indigenous chickens popular among farmers in tropical countries like Kenya. Improving the productivity of the indigenous chickens will be a vital step in elevating the livelihoods of communities in rural areas and the ever-increasing supply gap of poultry products. Indigenous chicken production in Kenya is largely small-scale at a subsistence level. Small-scale production systems are characterised by small flock sizes and higher production costs per bird. Consequently, the economic potential of indigenous chickens remains underexploited. Research suggests that the commercialization of indigenous chicken farming could improve productivity. Indigenous chickens can perform well under enhanced management. The expansion of flock size coupled with the employment of modern rearing techniques will make indigenous poultry farming a profitable venture (Njuguna et al., 2018).

Tapping into their natural scavenging ability and adaptability to locally prevailing environmental conditions, indigenous chicken could be reared on locally available feed resources including insects as an alternative protein source (Onsongo et al., 2018), this could help to reduce the cost of production. Further research on the nutritional and performance impacts of the locally available feed resources including insects, seaweeds, and other unconventional feed resources is imperative, especially in the face of constrained supply and foreign reliance on imported corn and soybean meal.

To initiate sustainable genetic improvement of indigenous chickens, thorough research on their production characteristics and the basis of genetic variability is necessary (Gheyas et al., 2021). The application of modern breeding biotechnologies will contribute to deciphering the basis of genetic variation in indigenous chickens (Chesoo et al., 2021). Genetic selection and the use of modern chicken husbandry practices will go in hand to fully utilise the indigenous chicken genetic resource. Additionally, the upscaling of government support to farmers through the provision of extension services and financial incentives could accelerate commercialization (Mutombo et al., 2015). Proper governmental regulation of the marketing system, vital infrastructural improvements, and disease control could be vital in enhancing indigenous poultry production. Farmers could also be encouraged to form groups which will grant them more bargaining power, training, and better access to market information (Ayieko et al., 2015).

To enhance the productivity of indigenous chickens, it is equally necessary to encourage farmers to join cooperatives and farmers' groups for the ease of furnishing them with extension, production, and marketing information (Tanui et al., 2022). Due to the absence of appropriate technology and knowledge, the value addition of poultry products has been determined to be low (ROK, 2013). The use of farmer groups and cooperatives could ease the value-addition technology transfer and training to indigenous chicken farmers to enhance their marketability in the local and foreign export markets. Although local chicken products are highly preferred by consumers, it is also recommended that their eco-labelling and traceability be improved to enhance the safety aspect of food security (Bett et al., 2013).

CONCLUSIONS

Indigenous chickens are an important source of food, livelihood, and income for many households. They also serve important immeasurable social-cultural functions. Although indigenous chickens are widely reared in Kenya, their productivity is suboptimal. The potential of indigenous chickens in economically, empowering communities is still largely underexploited. This could be attributed to the various constraints that hinder their large-scale production and commercialization. The mitigation of the challenges and the exploitation of the available opportunities through the commercialization of indigenous chicken rearing alongside increased governmental support through market control and research funding for genetic improvement has the potential to improve the productivity of indigenous chicken. Policies that will streamline the value addition and marketing of poultry products will be crucial in enhancing the profitability of the indigenous chicken industry. Enhancing chicken productivity will be crucial in the achievement of Kenya's mid and long-term plans for economic transformation and the reduction of poverty levels.

POTENTIAL CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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