Economic and marketing performance of chicken value chain actors in Nigeria: Challenges and business opportunities for sustainable livelihood

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Economic and marketing performance of chicken value chain actors in Nigeria: Challenges and business opportunities for sustainable livelihood

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Acronyms

ACGG	African Chicken Genetic Gains
BMGF	Bill & Melinda Gates Foundation
DOCs	Day-old chicks
FAO	Food and Agriculture Organization of United Nations
GDP	Gross domestic product
GFI	Gross farm income
GM	Gross margin
ILRI	International Livestock Research Institute
MRR	Marginal rate of return
NBS	National Bureau of Statistics
NFI	Net farm income
NGN	Nigerian Naira
PP	Producers price
PSh	Producers share
RP	Retail price
SD	Standard deviation
TAIBs	Tropically adapted improved breeds
TFC	Total fixed cost
TFI	Total farm income
TGM	Traders gross margin
TMu	Total mark-ups
TVC	Total variable cost

Executive summary

The African Chicken Genetic Gains (ACGG) program implemented a brief survey of chicken production and marketing activities of different value chain actors in Nigeria. The survey aimed to evaluate the economic performance of actors involved in chicken production and marketing and identify the main challenges along the value chain. The study adopted multistage sampling techniques that included selecting market sheds, producers and marketing actors. We selected three market sheds and two villages in each market shed purposively based on their poultry production and marketing potential. We selected smallholder producers, mother unit farms, layer farms, broiler farms, aggregators, wholesalers and retailers from each market shed. We interviewed each actor using a structured questionnaire on chicken production and marketing activities. The data were cleaned and summarized using proper procedures. Different production and marketing actors' economic and marketing performances were estimated using economic and financial analysis approaches such as partial budget analysis and conventional cost and benefit analysis techniques. This report presents the main findings on inputs use, reported outputs, economic and marketing performances, main challenges and opportunities, available business opportunities and recommended interventions and policy options along the value chain.

Smallholder poultry producers in the sampled market shed kept both improved and local breed chickens. Of the total respondents, 74.7 % had local breeds, while 62.1 % had improved breeds. Producers used hen, cocks, day-old chicks (DOCs) and pullets as foundation stock. Supplementary feeds and disease prevention and treatment were the main inputs used by smallholder producers. During the previous 12 months, all sampled respondents provided supplementary feeds to their chicken. Maize bran, commercial feeds and home-made mixed feeds were the main types of feeds provided by smallholder producers. Similarly, about 72.6% of sampled producers provided vaccination and disease treatment in the same period.

Most smallholder producers produced live chickens and eggs using local breeds. However, the productivity of these breeds seems low. On average, the local hen produced 38 eggs per year. For live chicken production, a producer set about 12 eggs in single hatching. The average reported hatchability and survival rates were 77.1% and 73.0%, respectively. In addition to local breeds, smallholder producers used tropically adapted improved breeds (TAIBs) to produce live chickens and eggs. For live chicken production, they used either dual-purpose or commercial line broilers. Under smallholder management conditions, an improved layer/dual-purpose breed hens laid an average of 216 eggs/ year.

We estimated the feasibility of adopting dual-purpose improved breeds using a partial budget analysis approach based on the premises found from sampled smallholder producers and mother unit farms. The analysis assumes shifting indigenous breed-based extensive production to dual-purpose breeds-based semi-intensive production system based on the Food and Agriculture Organization of the United Nations (FAO) poultry production classifications. In both scenarios, the main production outputs are live chickens for meat and eggs. We considered three main assumptions in this analysis: change in breed, flock size and modest change in management. The change in breeds refers to shifting existing indigenous breeds to TAIBs. The change in flock size refers to increasing the average flock size of extensive scavenging

(5–49) to the average flock size in semi-intensive production (50–200). In our context, we considered two flock size scenarios, 50 and 75. Results from the partial budget analysis indicate, in both flock size scenarios, shifting the production system from extensive scavenging to TAIBs- based semi-intensive production system generates substantial gain in income for smallholder producers. For example, under the 50 flock size scenarios, smallholder producers can generate about 297,000 Nigeria Naira (NGN) additional gain in income in one production cycle (18 months). Furthermore, the estimated marginal rate of return is about 366.9%, suggesting each NGN invested in TAIBs-based production generates an additional NGN3.7 as a return. The estimated economic performance indicators clearly show that adopting a TAIBs-based production system is economically feasible.

Under smallholder improved breeds-based production systems, mother unit farms have vital roles. Mother units have significant contributions to transforming indigenous breeds-based low-input low-output production into TAIBs-based semi-intensive and intensive production. These farms raise DOCs for certain days during the early growth stages, where chicks are highly vulnerable to disease and predator attacks, and sell to smallholder producers for a live chicken and eggs production. On average, sampled mother unit farms raised about 722 chicks/batch, seven batches per year. Like other commercial producers, they used standardized production inputs such as commercial feeds, vaccination and housing. The cost of DOCs and feed accounted for 43.8% and 31.9% of the total variable costs, respectively. Mother unit farms generated a 34.8% gross margin per annum with an average net farm income of NGN922,500. Despite some reported challenges, most mother unit farms were economically feasible and could generate employment opportunities along the smallholder chicken value chain.

We examined the production and marketing activities of selected small-scale commercial layer farms using the reported input and output data. Sampled commercial layer farms had about 2,985 layers during the survey, with a minimum of 500 and a maximum of 7,000 birds. Among the variable inputs used, 87.7% of the total variable cost accounted for feed, followed by hired wage and DOCs (5.02% and 5.06%, respectively). Layer farms generate income from the sale of eggs, sale of spent hens and manure sales. The production activities of sampled layer farms look economically feasible. Layer farms generated a 43.1% gross margin in one production cycle with an average net farm income of NGN6,353.1 per layer. These farms would generate a significant economic contribution to farm owners and the local community. However, high feed cost, lack of skilled farm operators, disease outbreak, egg breakage and spoilage, extreme weather conditions and limited access to finance were reported as major constraints.

The economic feasibility of small-scale broiler farms was also assessed using reported values of inputs and outputs. In one production cycle, sampled broiler farms had an average of 257 chicks at the starter stage with a survival rate of 92.6% at the finisher stage. On average, the reported production batches per year was four. The cost of feeds and DOCs accounted for 57.5% and 25.9% of the overall variable cost of production, respectively. Broiler farms generated income from the sale of live chickens or meat and manure. The estimated economic performance shows that these farms generated a positive return. The average gross margin for sampled broiler farms was about 55.1%, with a minimum of 15.7% and a maximum of 83%. On average, sampled broiler farms generated about NGN1,407,700 net farm income per year. Despite their significant economic contributions, sampled farms reported disease, high input cost, limited access to finance and inadequate market opportunities as major constraints.

We assessed the marketing activities of traders such as aggregators, wholesalers and retailers using data generated from sampled respondents. These actors play a significant role in live chicken and egg marketing. Smallholder producers and commercial producers were the main suppliers of eggs and chicken to traders. According to sampled respondents, live chicken trading involved various marketing costs, including feed, labour, disease treatments, shop rent, transportation and other miscellaneous expenses. Similarly, egg trading involved transport, labour and shop rent costs. Both live chicken and egg traders reported their experience of the physical loss of products for several reasons. Compared to egg traders, live chicken traders were exposed to higher marketing costs and significant loss of chickens due to disease and physical damage. The average estimated gross marketing margins show that most of them generated modest income to support their livelihoods. According to live chicken traders, disease or death of chickens, high transportation cost, limited

access to finance, high feed cost, security problems were the main challenges in their trading activities. Similarly, egg traders' main challenges were inadequate transportation facilities, egg spoilage, egg breakage, and egg size variation. The presence of multidimensional challenges in marketing activities may suggest the inefficiency of the existing marketing system that should be addressed through policy and development interventions.

We assessed the contributions and challenges of small-scale processors using fewer selected processors around the sampled market sheds. We interviewed individuals who provide slaughtering services and small-scale processors about major processing activities and existing challenges in their business. Usually, slaughtering service providers are found around the live chicken retail and wholesale markets. These processors provide slaughtering services for the individual consumer at NGN100–200 per chicken as a service fee. However, most of them provide the service with poor slaughtering facilities. The small-scale commercial processors operate with better processing facilities, and they process and sell chicken meat to different customers. Given their significant economic and social contribution, the individual slaughtering service provision and small-scale processing activities need better policy and development interventions.

The production and marketing performance indicators show current business opportunities that generate additional income and employment opportunities in the smallholder and small-scale commercial poultry production value chains. This may include small-scale local hatchery services, mother units, local feed mixing and supplies, poultry health service provision, semi-intensive and small-scale intensive poultry productions, product collection and distribution, and small-scale processing and slaughtering services. Exploiting these business opportunities needs developing an innovative and inclusive business model that integrates input delivery, production, processing, output distribution and marketing activities along the value chain.

This brief production and marketing assessment generated various lessons and recommendations that need further research or development interventions to enhance the performance of the value chain. Among others, the following issues could be considered while designing research and development interventions in the country.

- A higher tendency of smallholder producers' feed and vaccination use in indigenous breeds-based production depicts their willingness and ability to improve the widespread traditional low-input and low-output production system and improve production practices. However, a higher level of input use alone may not guarantee a feasible economic and financial return for resource-poor households due to the poor genetic potential of indigenous breeds. This may suggest the need for testing, identifying and disseminating farmer-preferred and locally adapted improved breeds suitable for the smallholder production system in the country.
- Smallholder producers' experience in adopting TAIBs-based production systems shows these breeds could generate significant economic and social gains under smallholder management conditions. Nevertheless, sustained adoption of these breeds requires developing context-specific business models and supporting institutions that enhance the continued dissemination of breeds and address major production and marketing constraints.
- Despite a wider use of vaccinations and treatments, poultry disease remains the major production and marketing constraint along the value chain, including product marketing. Especially, failures of vaccines and treatments seem to exasperate the research and development efforts that aim to enhance smallholder chicken production and productivity. Based on lessons learned from previous and current disease management practices, it is vital to identify innovative and sustainable health strategies to minimize the incidence and impact of poultry diseases.
- Smallholder producers' production and marketing challenges could be directly or indirectly associated with limited vertical and horizontal coordination along the value chain. This may suggest strengthening smallholders and other actors' linkage through strategies such as producers' association, traders' association and inputs supply and production agreements. These would enhance the competitiveness and efficiency of the value chain by improving productivity and product quality, reducing costs and risks, sharing market information, and creating a reliable supply of inputs and outputs.
- For a sustainable transformation of subsistence-based traditional smallholder chicken production to a commercially oriented semi-intensive production, building the capacity of smallholder producers and traders should be integral components of research and development interventions.

- For sustained production and productivity gains, interventions that aim to enhance the production and productivity of smallholder producers must be aligned with marketing intervention. Marketing interventions may include improved market access, enhanced physical market infrastructure and facilities, access to market information and finance, products standardizing and grading, products collection and distribution, and value addition through processing, packing and storage.
- Compared to smallholder producers, commercial producers have better access to production inputs, markets and other productivity-enhancing technologies. Under current conditions, the commercial production sectors have greater expansion prospects and better economic returns than indigenous breeds-based smallholder production. Unless the productivity of smallholder chicken production is improved, in the future, faster growth of the commercial sector would challenge the sustainability of smallholder production that supports the livelihood of millions of resource-poor households in rural and peri-urban areas.
- Finally, multiple productions and marking challenges reported under the traditional smallholder chicken production system indicate the need for developing an inclusive and dynamic business model that would transform the sector to at least a semi-intensive production system. The business model should focus on improving genetics, enhancing access to locally available and low-cost inputs, capacity building and collective actions, improving access to inputs and output markets, and women empowerment. This improves the supply of eggs and meat to smallholder producers and the growing population in the rural and urban areas.

1. Introduction

Poultry production in Nigeria supports the livelihood of millions of smallholder producers and other value chain actors such as input suppliers, commercial producers, traders, processors and consumers. It generates food for rural and urban populations, income for producers, and manure for crop production. It also has a significant contribution to fulfilling other social and cultural obligations. Despite its multidimensional contribution to the livelihood of resource-poor households, compared to developed and other developing countries, the production and productivity of smallholder chicken production in the country is low (Ajayi, 2010, Yakubu, 2010). For example, a recent survey indicates that only 68.2% of the smallholder poultry holders produced eggs in the previous three months, with an average of 26.2 eggs (NBS, 2019). This could be associated with the type of breeds, inadequate management, limited institutional support, limited access to market, and policy and environmental-related factors that should be addressed through integrated interventions. Hence, together with national partners, the International Livestock Research Institute (ILRI) has implemented the African Chicken Genetic Gain (ACGG) project in Nigeria since 2014. The project has executed various interventions to enhance the production and productivity of smallholder chicken production in the country. The primary interventions included testing and identifying tropically adapted improved breeds (TAIBs) suitable for different agro-ecologies, facilitating the delivery of identified breeds, building the capacity of smallholder producers and mother unit farms, and establishing innovation platforms to enhance the performance of the value chain.

Data generated from on-farm experiments and the project monitoring suggest that some of the introduced genotypes have improved the production and productivity of smallholder producers and can create employment opportunities along the value chain. However, quantitative evidence on the economic contribution of adopting the introduced breeds and marketing performances of other value chain actors remains inadequate. Therefore, we conducted this assessment in 2019 to evaluate the economic and marketing performance of TAIBs-based smallholder chicken production and other value chain actors such as mother unit farms, small-scale commercial producers, traders and processors. The assessment updates available evidence on poultry production and marketing and generates additional insights on the current economic performance of different production and marketing actors. The main aim of the assessment was to estimate the cost and benefits for different actors, identify main production and marketing constraints, and explore business opportunities along the smallholder poultry value chain. This report summarizes the main findings and presents research and development interventions to enhance the future production and marketing performance of smallholder chicken production in Nigeria.

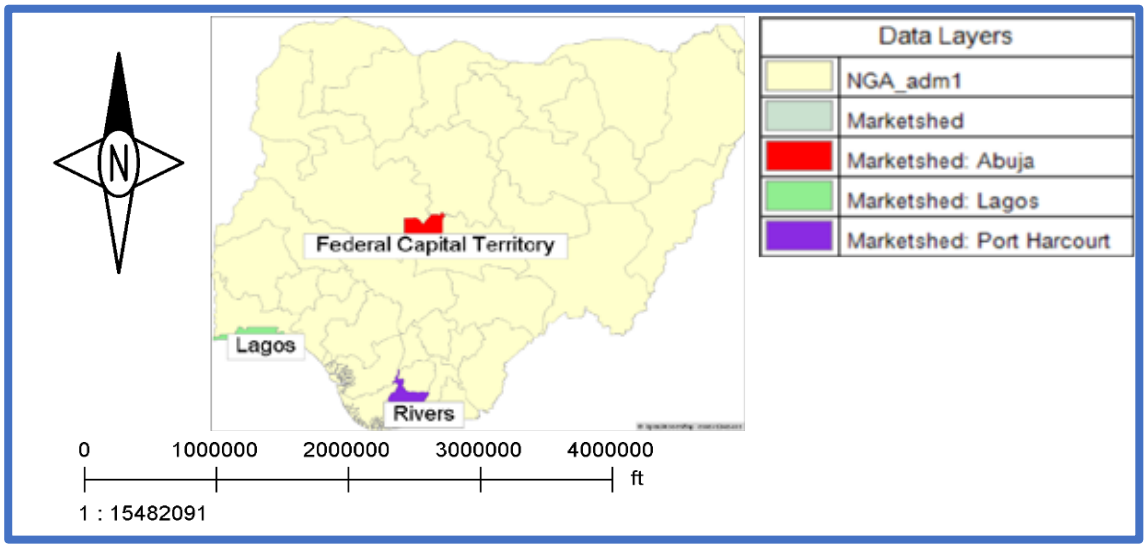
The report is organized as follows: Sections 2 and 3 summarise the research approach adopted and an overview of the poultry production sector in the country, respectively. Section 4 summarizes the economic performance of smallholder chicken production in the sampled market sheds. Then Sections 5, 6 and 7 present the productions, marketing, and economic performance of mother units, small-scale layers, and small-scale broilers farms, respectively. Sections 8 and 9 present main findings on marketing actors such as aggregators, wholesalers and retailers, and small-scale chicken meat processors. Section 10 presents business opportunities along the smallholder value chain. Finally, the main lessons learned and possible research and development interventions are presented in Section 11.

2. Methodology

2.1 Sampling and sample sizes

A multistage sampling technique was applied to select respondents along the poultry value chain. In the first stage, three market sheds were selected purposively based on their level of chicken production and the availability of various production and marketing actors. The market sheds were selected from three locations, namely Lagos (Lagos), Federal Capital Territory (Abuja) and Port Harcourt, Rivers State (Figure 1). Then, we selected two villages purposively with different types of producers and marketing actors from each market shed. From each village, we randomly selected 15-16 smallholder producers. A total of 95 smallholder chicken producers were sampled for the face-to-face interviews from the six villages. Similarly, we selected 5–10 commercial producers in each market shed based on their availability around the market sheds. Furthermore, based on their accessibility, we purposively selected poultry marketing places to interview different marketing actors such as aggregators, wholesalers and retailers. Forty-one different types of traders were randomly selected and interviewed on poultry products marketing.

Figure 1: Map of market sheds selected for the assessment.



Source: Created by authors

2.2 Data management and analysis

Data from all selected actors were collected using structured questionnaires using paper-based interviews. The data collection instruments had different sections, including production, marketing, coordination and collective action, and challenges and opportunities along the value chain. After coding, the data were entered into SPSS and transferred to Stata for data cleaning, management, generation and analysis activities. Then, we summarized the data using descriptive

statistics and different economic performance analysis techniques. The economic performance analysis approaches include partial budget analysis and conventional cost-benefit analysis. We also estimated the gross margin and total mark-ups of marketers to evaluate the marketing margins of different traders and the existing variability among sampled market sheds.

Partial budget analysis is the most widely applied farm management tool used for decision-making in technology adoption (Brown, 1979, Soha, 2014). We applied the partial budget analysis to estimate the gain in income from shifting indigenous breeds-based extensive production to dual-purpose breeds-based semi-intensive production. The partial budget analysis has four major sections: added income, reduced income, added cost and reduced cost. In our context, added income refers to the income generated from a semi-intensive-based production system. The reduced cost is the sum of the costs forgone due to a shift in production or costs associated with extensive-scavenging production. Reduced income refers to the income given up due to a shift in the production system or income from extensive scavenging. The added cost is the cost associated with the semi-intensive production system. While the sum of added income and reduced cost give the total gain (TG), the sum of reduced income and added cost give us the total loss (TL). The difference between total gain and total loss gives us the net gain (NG) in income.

$$\mathrm{TG} = \mathrm{ADIN} + \mathrm{RDCO} \quad (1)$$

$$\mathrm{TL} = \mathrm{RDIN} + \mathrm{ADCO} \quad (2)$$

$$\mathrm{NG} = \mathrm{TG} - \mathrm{TL} \quad (3)$$

Where TG=total gain; ADIN=added income; RDCO=reduced cost; TL=total loss; RDIN=reduced income; ADCO=added cost; NG=net gain.

We applied the conventional cost-benefit analysis for commercial farms (mother units, broilers and layers) and generated gross farm income, gross margin and net farm income as economic performance indicators for these farms. We estimated these indicators using the following formula.

$$\mathrm{GFI} = \mathrm{TFI} - \mathrm{TVC} \quad (4)$$

$$\mathrm{GM}\ (\%) = \frac{\mathrm{TFI} - \mathrm{TVC}}{\mathrm{TFI}}\ \mathrm{X}\ 100 \quad (5)$$

$$\mathrm{NFI} = \mathrm{TFI} - \mathrm{TC}(\mathrm{TVC} + \mathrm{TFC}) \quad (6)$$

Where GFI=gross farm income; TFI=total farm income; TVC=total variable cost; GM=gross margin; NFI=net farm income; TFC=total fixed cost; TC=total cost.

We estimated producers share, gross margin, and total mark-ups for traders to assess the marketing margins and existing variability among sampled traders.

$$\text{PSh}\ (\%) = \frac{\text{PP}}{\text{RP}}\ \text{X100} \quad (7)$$

$$\text{TGM}\ (\%) = \frac{\text{RP} - \text{PP}}{\text{RP}}\ \text{X100} \quad (8)$$

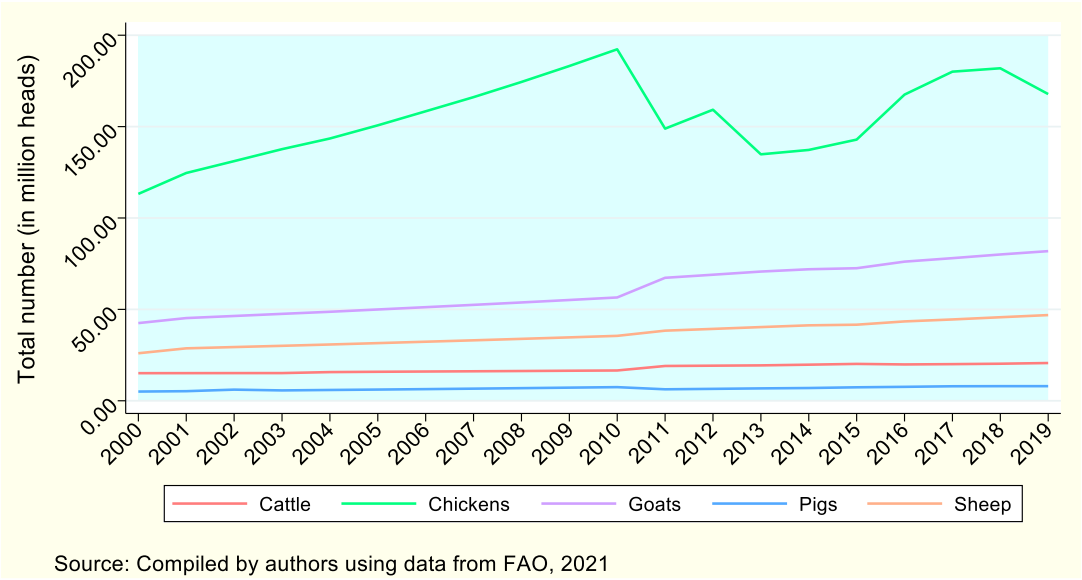
$$\text{TMu}\ (\%) = \frac{\text{RP} - \text{PP}}{\text{PP}}\ \text{X}\ 100 \quad (9)$$

Where PSh=producers share; PP=producers' price; RP=retail price; TGM=traders' gross margin; TMu=total markups.

3. Overview of poultry production and consumption in Nigeria

Agriculture makes essential economic contributions to Nigeria's economy, with 70% of the population engaged in agricultural activities (WB, 2019). The agricultural sector contributes about 21.96 % of the GDP in 2020 (quarter 3) (NBS, 2020). Livestock production contributes about 6–8% of GDP (FAO, 2018), and the sector includes cattle, sheep, goat, pigs, and chicken production. Chicken is the largest livestock population in the country, and next to goats, it is the most commonly owned (64.8%) livestock (NBS, 2016). In 2019, the total chicken population was 167.81 million, followed by goats (81.88 million) and sheep (46.89 million) (Figure 2). During 2000–2019, on average, the chicken population grew by 2.50%. However, the overall chicken population growth shows a mixed trend, and there was a significant decrease after 2011. Considering 2010 as a reference period, the increase in 2011 was about -22.58 %, due to disease outbreaks and other reasons.

Figure 2: Trends of total livestock population in Nigeria (2000–19).



Source: Compiled by authors using data from FAO, 2021

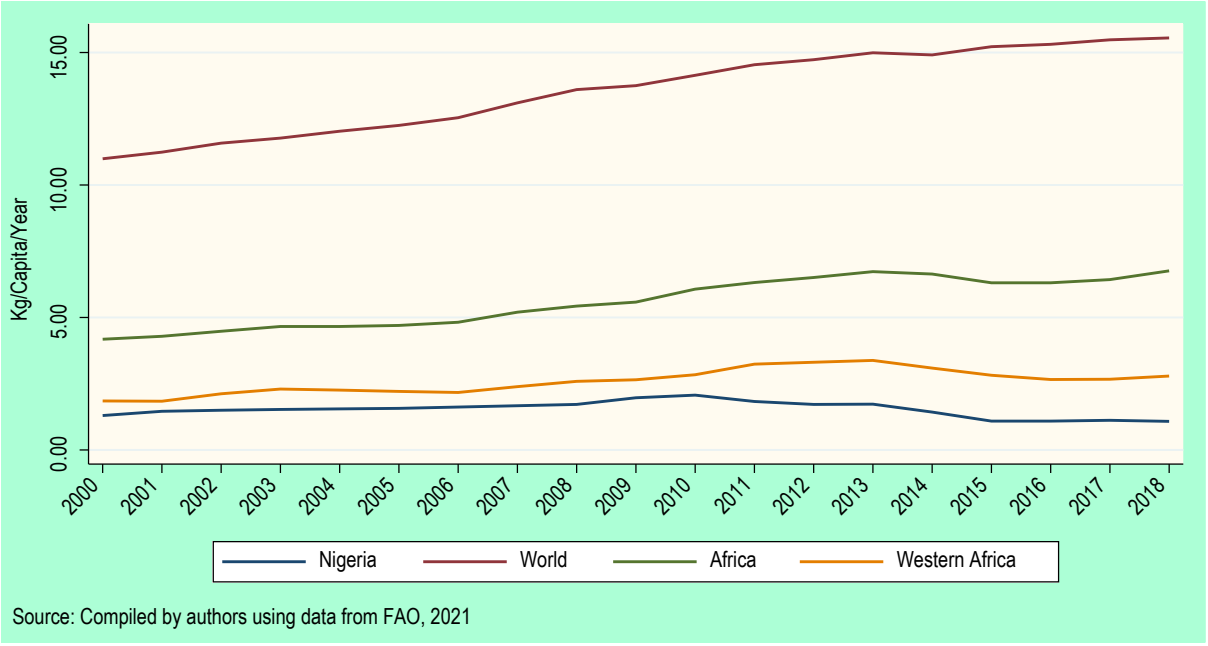
The poultry production system in Nigeria can be divided into extensive traditional production (free-range), semi-intensive production, and intensive or commercial production systems (FAO, 2018). In the free-range traditional production system, farmers keep less than 50 indigenous chickens that roam around the home. This production system is subsistence-oriented, mainly intended for own consumption and additional income generation. In the semi-intensive production system, farmers keep both indigenous and improved breeds of flock size 50–2000. Unlike the extensive system, smallholder producers in this system provide better feed and management, and they consider the production as complementary to other farming activities. Producers keep commercial line breeds in the commercial or intensive production system either for egg or meat production. This system includes medium- and large-scale commercial

producers that keep more than 2,000 birds. The commercial production system includes hatcheries, mother units, and broiler and layer farms.

Trends in poultry products supply and consumption

Although Nigeria is one of the African countries with the highest poultry population, it had the lowest per capita poultry meat consumption compared to global, regional and sub-regional averages during 2000–2018 (Figure 3). The overall average annual consumption was 1.53 kg/capita, which is significantly lower than the world average (13.56 kg/capita) and the regional average (5.58 kg/capita). During the same period, the average annual consumption in Western Africa was 2.59 kg per capita. Due to the lower domestic poultry meat supply, the country is one of the major importers of poultry meat in the region and Africa. In 2018, the country imported USD30.17 million worth of chicken meat from different countries (FAO, 2021). This shows existing gaps in the supply and demand of poultry meat in the country and the need for enhancing domestic production and productivity in the future.

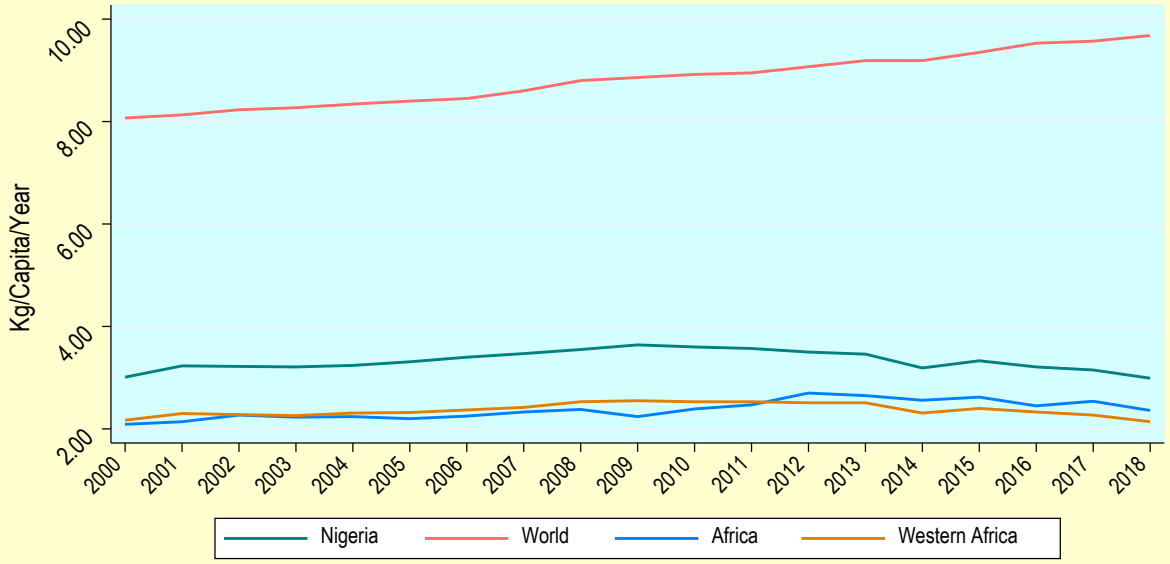
Figure 3: Trends of poultry meat supply in Nigeria and other countries (2000–18).



Source: Compiled by authors using data from FAO, 2021

Unlike poultry meat, Nigeria's average annual per capita egg consumption was higher than the average regional and sub-regional consumption. However, compared to global consumption, it was significantly lower. During 2000–18, the average annual egg consumption was 3.33 kg/year, while the average global consumption was 8.82 kg/year (Figure 4). The average per capita consumption of eggs in Africa and Western Africa for the same period was 2.37 kg/year.

Figure 4: Trends of egg supply in Nigeria and other countries (2000–18).



Source: Compiled by authors using data from FAO, 2021

4. Economic performance of smallholder chicken production

Indigenous breeds-based smallholder chicken production system accounts for the largest proportion of chicken producers in Nigeria, like in most developing countries in the world (FAO, 2018). This production system is characterized by low-input low-output production with a limited commercial orientation of producers. Despite various research and development efforts that aimed to enhance the overall production and productivity of the sub-sector, observed gains in production and productivity had been limited in the previous few decades. This could be associated with traditional farming practices generally employed by producers, limited access to technologies, poor policies, limited institutional support, inadequate access to input and output markets, and other socio-economic, cultural and environmental factors.

The economic performance of smallholder chicken production depends on the production and marketing performance of producers. This can be measured by analysing the nature and type of inputs used, cost of production, level of production and value of products generated from the production system. In the following subsections, we present a brief overview of chicken holdings, main types of inputs used, the output produced, marketing channels for products, main production and marketing constraints and reported opportunities. Finally, we present the economic return from adopting TAIBs-based semi-intensive production compared with the widely adopted extensive scavenging system.

4.1 Type and number of chicken holdings

From the three selected market sheds, 95 smallholder producers participated in the face-to-face interviews. Of these respondents, about 80.3% and 19.7% were male and female household heads, respectively. Sampled respondents had an average of 16.2 local and 16.9 improved chickens (Table 1). Smallholder producers had about 33 chickens, with a minimum of 2 and a maximum of 225. The maximum numbers of local and improved chicken holdings were about 159 and 100, respectively. The proportion of sampled respondents who keep local chicken was 74.7%, while the proportion of sampled respondents who keep improved chicken was 62.1%. This shows that most of the sampled respondents keep both improved and local breed chickens. However, some of the sampled respondents keep only either local or improved breeds.

Table 1: Numbers of local and improved breed chicken owned by smallholders

	Number of chickens				Proportion
Type of breed	Mean	SD	Min	Max	holders (%)
Local	16.2	21.1	0.0	159.0	74.7
Improved	16.9	22.7	0.0	100.0	62.1
Overall	33.1	32.0	2.0	225.0	

SD=standard deviation; Min=minimum; Max=maximum

4.2 Major types of inputs used in smallholder chicken production

4.2.1 Foundation stock

At the smallholder level, producers use diverse types of chicken as foundation stock, including day-old chicks (DOCs), pullets/cockerels, hens and cocks. From the sampled respondents, 47.4% and 45.3% of them used hens and improved pullets/cockerels (45 DOCs) as foundation stock, respectively (Table 2). Most producers who started with DOCs and pullets or cockerels were holders of improved breeds. The proportion of respondents who began with DOCs was 17.4%, and those that started with mature cocks were 22.1%. The average numbers of chickens used as foundation stock were about 39.8 DOCs, seven hens, 19 pullets /cockerel and six cocks. The producers' minimum and maximum purchase prices vary with the type of chicken and year of purchase.

Table 2: Type and number of chickens used as a foundation stock

	Numbers of chicken					N(%)	Average price (NGN/chicken)		
Type of chicken	Mean	SD	Median	Min	Max		Mean	Min	Max
DOCs	39.8	34.2	34.0	4.0	102.0	17.4	122.5	30.0	250.0
Pullet/cockerel	18.7	16.6	13.0	2.0	90.0	45.3	529.4	40.0	1,500.0
Hen	6.5	9.7	3.0	1.0	50.0	47.4	932.4	160.0	2,500.0
Cock	5.7	6.8	5.0	1.0	30.0	22.1	1207.5	250.0	3,000.0

SD=standard deviation; Min=minimum; Max=maximum

4.2.2 Type of feed used by smallholder producers

Feed is one of the key inputs used by smallholder producers. It can be sourced from households' crop production or purchased from local markets. In this assessment, we asked smallholder producers to report the type, amount and value of chicken feed used in the previous 12 months (Table 3). Surprisingly, all the sampled smallholder producers said they provided supplementary feed during the last 12 months, indicating that existing smallholder chicken production is strongly associated with feed costs. Most smallholder producers, 97.9%, provided maize bran and 72.6% provided commercially produced feeds. Others also offered a mix of grains and other crops that mainly contains cereals, root crops, vegetables and minerals. If the producers keep both local and improved breeds, they usually provide different feeds for the two breeds. Producers used commercial feeds mainly for improved breeds than for local breeds. The reported higher proportion of smallholder producers that use the supplementary feed in the indigenous breed-based smallholder production system might indicate an existing interest in improving the sector's production and productivity and increasing the use of supplementary feed in the sector. This could be associated with decreasing trend in scavengeable feed sources, better knowledge of poultry nutrition, and change in perception to improve the production and productivity of chicken.

Table 3: Major type and source of feed used by smallholder producers

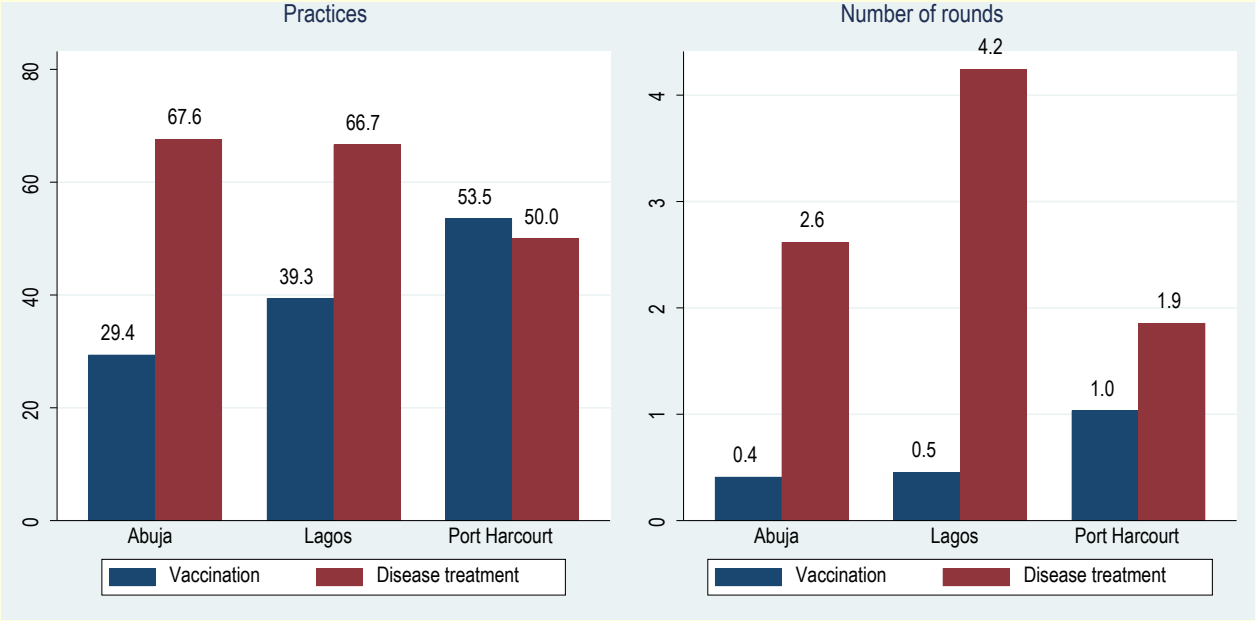
	Yes		No	
Type of feed	N	%	N	%
Maize bran (own + purchased)	93	97.89	2	2.11
Commercial	69	72.63	26	27.40
Mixed (own +purchased)	42	44.21	53	55.80
Total	95	100.00		

SD=standard deviation; Min=minimum; Max=maximum

4.2.3 Vaccination and disease treatment

Smallholder chicken production is widely known for limited vaccination and disease treatment practice and the absence of any biosecurity measures (Oladiran and Kabir, 2015). As a result, this production system is characterized by a higher level of mortality and disease outbreaks. These could be associated with inadequate management that includes poor feeding and housing practices. We asked sampled producers if they carried out any vaccination and disease treatment in the previous 12 months. Accordingly, 72.6% of the producers said they carried out either vaccination or disease treatment during the last 12 months. Disaggregated by market sheds, the summaries of responses are presented in Figure 5. The proportions of producers who carried out disease treatment were greater than those who did the vaccination. There were also differences in vaccination and disease treatment practices among the three market sheds. For example, compared to Port Harcourt, more producers in Lagos and Abuja carried out disease treatment in the previous 12 months. On the other hand, the proportion of producers who carried out vaccination was higher in Port Harcourt than in the other two market sheds. The overall average number of vaccinations among sampled respondents was about 0.61 rounds, less than 1. Similarly, the average number of treatment rounds was 2.9, indicating sampled producers had about three rounds of treatments in a year.

Figure 5: Smallholder vaccination and disease treatment practices in 12 months.



Source: ACGG Market Survey

Newcastle disease, worm infestation and other bacterial diseases are the major poultry diseases in Nigeria (Balami et al., 2014, Anzaku et al., 2017). Therefore, for enhanced production and productivity, producers should adopt innovative vaccination and disease treatment strategies. Empirical findings show a strong positive correlation between participation in chicken vaccination and flock size under smallholder management conditions (Bruyn et al., 2017). However, vaccination failure was the main challenge reported by smallholder producers during our assessment. Most smallholder producers said that despite their continual effort to provide vaccination or disease treatment, it usually fails to protect the chicken from disease outbreaks. This could be associated with different factors such as lack of proper handling, quality and nature of vaccine, quality and nature of treatments, use of local antigens, immunogenic response inside the chicken body and inability to follow manufacturers' instructions (Sharif and Ahmad, 2018). Altogether, higher disease incidence and failures of vaccination and disease treatment efforts indicate the importance of the challenge in the sector and the need for designing innovative health services delivery interventions that enhance the production and productivity of the sector.

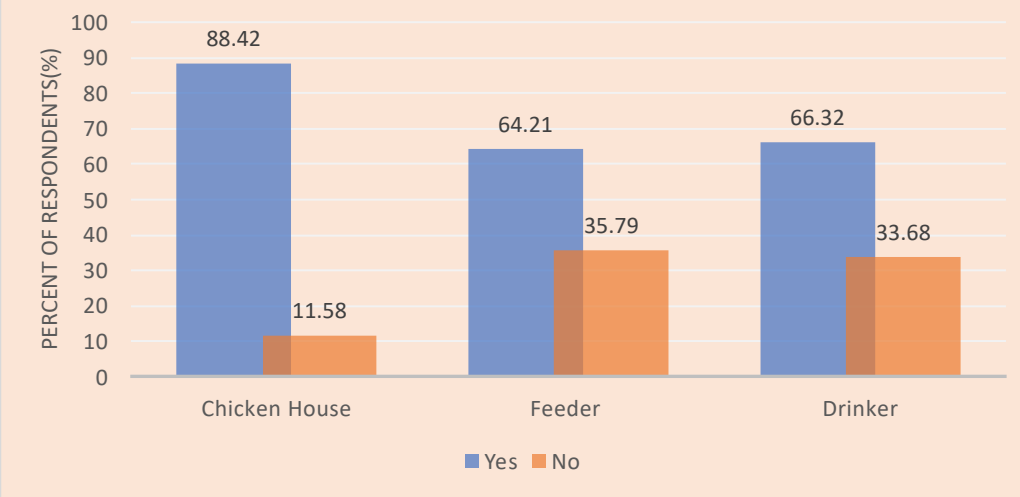
4.2.4 Family labour allocated to chicken management

Estimating the amount and value of time households spend on chicken management helps to understand producers' economic and social values to the production activity. This helps to design interventions and strategies that would enhance the production and productivity of the sector in the future (Sharma, 2013). Although smallholder chicken production is usually known for its low labour use, producers spend certain hours undertaking different production and marketing activities. At the farm level, main activities include providing feed and water, cleaning houses, disease treatment, protecting chicks from predator attacks and theft, egg collection and marketing products. During the face-to-face interviews, we asked producers, on average, how much time the family members spend conducting different management activities. A summary of the responses shows that, on average, producers spent 83 minutes/day, with a minimum of 1 minute and a maximum of 360 minutes on different management activities. When we disaggregate the amount of time spent by type of breeds, improved breeds, or both improved and local breed keepers spent 96 minutes/day while only local breed keepers spent about 60 minutes/day. Higher time allocated by improved/both breed keepers was expected due to better management required by the improved breeds. However, when we estimate the average amount of time allocated per chicken, the time allocated by improved/both breed keepers is lower (4 ± 5.1 minutes/chick) than only local breed keepers (6 ±13.3 minutes/chick). This is because keepers of improved/both breed own larger flock sizes than local breed keepers. A higher standard deviation among sampled respondents may indicate variability in allocated time among smallholder producers.

4.2.5 Housing and other fixed assets

Separate housing and other equipment that help to provide feed and water to the chicken are essential assets in smallholder chicken production. Poultry houses protect chickens from extreme weather conditions like warm and cool temperatures, predatory attacks and theft. Due to extreme hot and cool weather conditions in the country, the role of a proper housing system is pertinent. Similarly, the availability of feeders and drinkers has different benefits. Feeders and drinkers do not simply help to provide feeds and water but also helps to administer drugs and vitamins correctly. Feeders and drinkers improve chickens' health by minimizing contaminations of feeds and water with disease-causing agents. We asked sampled producers if they have used different fixed assets in the previous 12 months. Of the total respondents, 88.4% of the producers said they had separate chicken houses, and the rest keep chickens at home together with people (Figure 6). Most producers expressed their interest in improving the quality of chicken houses when they have access to financing. The proportion of producers who used drinkers and feeders were 64.2% and 66.3%, respectively. The highest proportion of producers had separate chicken houses and other fixed assets, indicating the existing attitudinal change among the sampled households toward better management options to enhance chicken production and productivity.

Figure 6: Proportion of producers who own chicken house, feeders and drinkers.



Source: ACGG market survey

4.2.6 Estimated cost of production

As indicated above, foundation stock, feed, vaccination and costs associated with fixed assets are the main inputs used by smallholder chicken producers in the study market sheds. Table 4 summarizes the reported cost of different inputs used by sampled respondents in a year. On average, producers who kept local and improved breeds incurred higher annual feed and vaccination costs than those who kept only local breeds. The average annual feed cost of local breed keepers was NGN1,381.3 per bird, while the average cost for both breed keepers was NGN1,790.0 per bird. Nevertheless, compared to the local breeds, the estimated average fixed asset depreciation cost for both types of breed keepers was lower than local breed keepers. Higher average fixed asset cost for local breeds keepers could be associated with the smaller flock size kept. The average number of flock sizes for both breed keepers was far higher than only local breed keepers.

Table 4: Estimated cost of different inputs used by smallholder producers

	Average cost of inputs (NGN/bird/year)					
	Only local		Improved and local		Overall	
Variable costs	Mean	SD	Mean	SD	Mean	SD
Feed	1,381.3	1,958.6	1,790.0	2,194.7	1,635.1	2,107.1
Vaccination/treatment	257.4	372.8	285.3	537.5	274.7	479.8
Total cost	1,638.7	1,935.8	2,075.3	2,245.9	1,909.8	2,133.8
Other costs						
Foundation stock	611.8	562.8	676.6	1241.6	652.1	1,034.4
Fixed assets depreciation	167.0	257.8	98.3	215.0	124.4	233.2

SD=standard deviation; Min=minimum; Max=maximum

4.3 Total production and productivity of chicken

Under the smallholder chicken production system, eggs and live chickens are the main outputs. However, if the producers keep many chickens, manure can also be considered as another output. Enhancing live chicken and egg productivity has a significant role in the sustainability of the production system. Given the limited resources smallholder producers have, productivity-enhancing technologies have a multidimensional contribution to the livelihoods of the producers (Fuglie, 2018). A better understanding of the sector's production and productivity level helps identify possible interventions and strategies that would have critical contributions to transforming the sector. In the following subsections, we present the reported levels of production and productivity of chickens among sampled respondents.

4.3.1 Eggs production and productivity

We asked producers about the number of layers they had, the average number of eggs produced and other productivity indicators in the previous 12 months. We asked these questions separately for hens of local and improved breeds. Over the last 12 months, 58.0% and 18.5 % of the total respondents had local and improved breed hens, respectively. The remaining 23.5% of the producers had both local and improved breed hens. The average numbers of local and improved hen holding were 5.6 and 5.3, respectively (Table 5). For local breeds, the average number of reported clutches per year was about 3.4, with a minimum of 2 and a maximum of 6 clutches. The average number of eggs produced per clutch was about 11.3, with an average clutch length of 16.6 days. The average number of eggs produced from local chickens was 37.5 hens per year, with a minimum of 12 eggs/hen/year and a maximum of 65 eggs/hen/year. The average number of eggs produced from TAIBs was 216 eggs/hen/year, with a minimum of 100 eggs/hen/year and a maximum of 300 eggs/hen/year. This shows that TAIBs can produce about five times more eggs under farmers' management conditions

than the local breeds. The higher number of eggs produced from improved breeds under smallholder management conditions has substantial implications for policies and interventions to improve smallholder chicken production and productivity in the country and other countries in the region.

Table 5: Egg production and productivity of smallholder producers

	Indicators				
Production/productivity indicators	Mean	SD	Min	Max	N
Local hen (no.)	5.6	9.1	0	65	95
Improved hen (no.)	5.3	12.3	0	80	95
Number of clutches/year	3.4	1.2	2	6	66
Eggs/clutch	11.3	3.0	6	25	66
Clutch length (days)	16.6	6.9	2	45	63
Local hen average eggs/year	37.5	11.5	12	65	66
Improved hen average eggs/year	216.0	62.9	100	300	30

SD=standard deviation; Min=minimum; Max=maximum; N=number of observations

4.3.2 Live chicken production and productivity

Live chicken production for home consumption and income generation is the primary purpose of smallholder chicken farming in Nigeria. But the total number of chicks produced depends highly on egg hatchability and the survival rate of chicks. Table 6 presents the estimated chick productivity for local chickens in the three market sheds. On average, sampled households had about five broody hens in the previous 12 months. A hen had an average of three hatching cycles per year. The average number of eggs set for hatching was about 10.5, with a hatchability rate of 77%. The average chick's survival rate to the grower stage was about 73%, which shows a 27% chick loss. Therefore, on average, a hen can produce about seven grower chickens in one hatching cycle.

Table 6: Chick productivity of smallholder producers

Indicators	Mean	SD	Min	Max
Number of broody hens	4.7	2.6	1.0	10.0
Number of hatch year	3.1	0.8	2.0	5.0
Number of eggs set	10.5	2.5	5.0	16.0
Eggs hatchability (%)	77.1	14.1	41.7	100.0
Chicken survival (%)	73.0	18.9	33.3	100.0

SD=standard deviation; Min=minimum; Max=maximum

Lower hatchability and survival rates could be associated with bird strain, egg weight, eggshell thickness and porosity, shape index (described as maximum breadth to length ratio), heat stress, egg storage, and other management and environmental factors (King'ori, 2011). Management factors include disease treatment and prevention, feeding and housing-related factors. Some respondents have explained that disease and predator attacks are the major challenge for losing chicks at early growth stages. Environmental factors may include extreme weather conditions such as high/low temperature, floods and drought. Evidence on improving the survival rate of chicks under smallholder production suggests the need for adopting innovative approaches in health, feed and housing systems (Sodjinou et al., 2013).

Under an improved production system, smallholder producers can adopt two approaches to produce live chicken for meat: using commercial broiler lines and using TAIBs. The former approach needs intensive care and an advanced management system, which is usually challenging under smallholder management conditions. As indicated above, under the foundation stock subsection, in the latter approach, smallholder producers can purchase 45 DOCs and raise them for about three months. Unlike the indigenous breeds-based production, dual-purpose breeds-based production allows

smallholder producers to raise chickens based on market demand and available resources. Since the chicks receive all the necessary vaccination and treatment at the mother unit farms, usually there is a lower mortality rate. Moreover, the fast growth rate of these chickens would have different economic and social benefits. For instance, in the past 12 months, 26.3% of the sampled smallholder producers reported they produced and sold improved-breed cockerels. The above live chicken production and productivity indicators demonstrate the lower productivity of indigenous breeds-based production and the contribution of TAIBs to enhance smallholder chicken production and productivity.

4.4 Marketing of poultry products

4.4.1 Smallholder producers' market participation

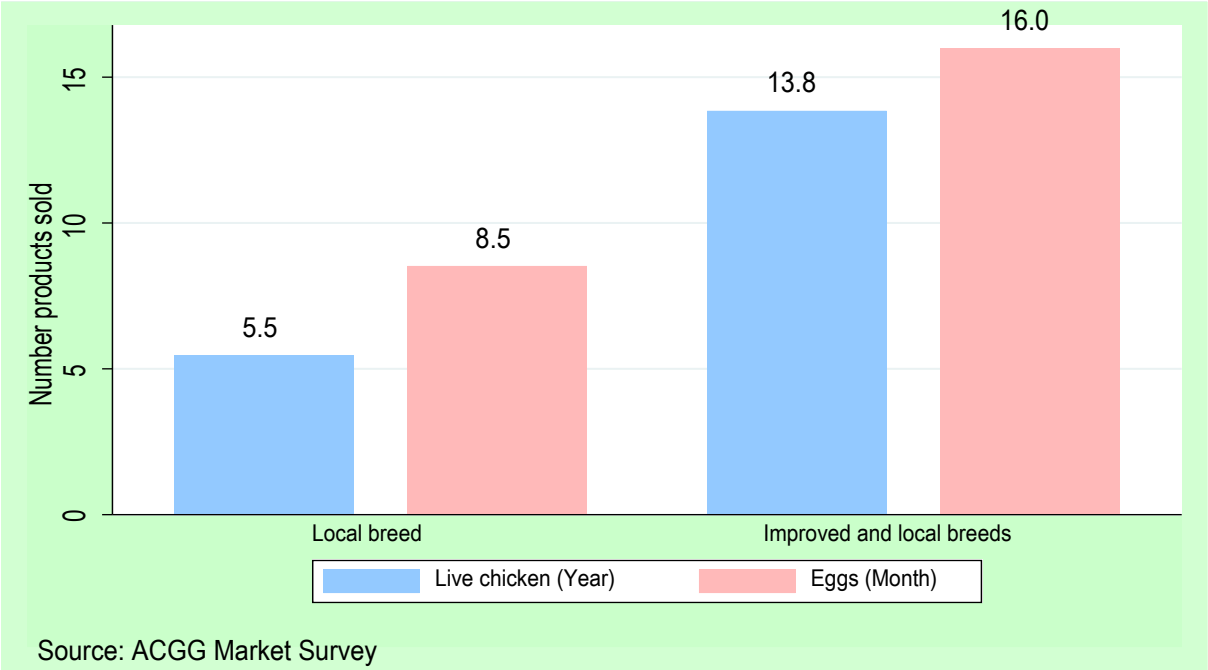
Smallholder producers' market participation depends on various factors such as level of production, access to market, households' income and wealth status, and other socio-economic factors. We asked sampled producers if they participated in live chicken and egg marketing in the previous 12 months. A summary of the findings shows that 84.2% and 37.9% of the producers partook in live chicken and egg selling, respectively (Table 7). From the total respondents, only 10.5% of them did not participate either in live chicken or egg selling. Moreover, from producers who participated in live chicken selling, 51.58% participated only in live chicken selling while 32.63% of them participated in both live chicken and egg selling. Likewise, from the total producers who participated in egg selling, 5.26% participated only in egg selling. The above findings show that most smallholder producers participated in live chicken marketing than egg marketing. This could be associated with low eggs production and smallholder producers' priority to use local breeds for chick production rather than egg production.

Table 7: Smallholder producers market participation in the previous 12 months

	Number of producers	
Product type	N	Per cent (%)
Only eggs	5	5.26
Only live chickens	49	51.58
Both	31	32.63
None	10	10.53
Total	95	100.0

When the total number of live birds and eggs sold is disaggregated by breed holding, there is a significant association between breed holding and market participation (Figure 7). Improved and local-breed keepers sold more eggs and live chicken than local breeds only keepers. On average, improved and local-breed keepers sold higher numbers of live chickens than local-breed keepers. Similarly, the average number of eggs sold by improved and local breed keepers was about two times higher than only local breed keepers. This shows that smallholder producers market participation seems highly associated with production and productivity, which signposts higher-level production could lead to higher market participation.

Figure 7: Average number of live chickens and eggs sold by type of breeds kept.

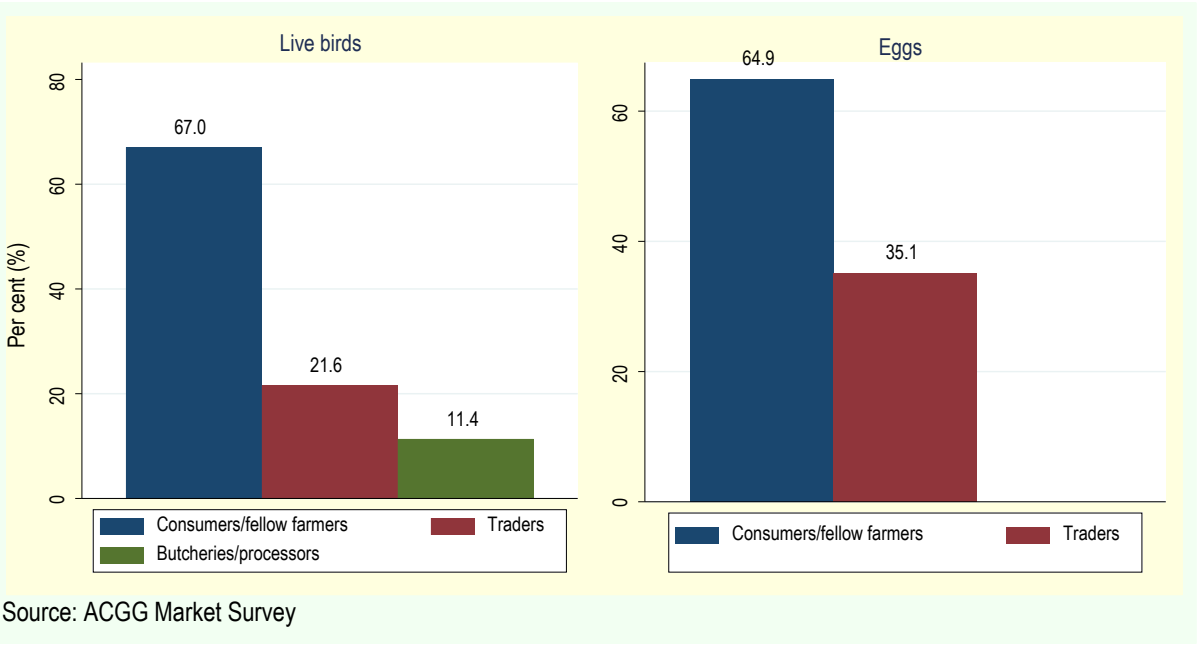


The data on market participation indicate most of the smallholder chicken producers participated in eggs and live birds marketing. In addition to its contribution to enhanced household consumption, a higher level of market participation shows the contribution of smallholder chicken production in households' income generation to support the livelihood of producers. Most of the respondents reported that they use the sale proceeds to cover planned and unplanned expenses such as children's school fees, medical payments, purchase of other agricultural inputs, as well as other food and non-food household items.

4.4.2 Type of live chicken and eggs buyers

Smallholder chicken producers sell their products to different buyers such as individual consumers, fellow farmers, aggregators/collectors, processors and other retailers. In the previous 12 months, producers sold live chickens to individual consumers/fellow farmers, processors, aggregators/collectors or traders (Figure 8). However, individual consumers and fellow farmers were the most important live chicken buyers. From total reported buyers, individual consumers/fellow farmers accounted for 67.0% of the buyers, and the remaining 21.6% and 11.4% accounted for aggregators/retailers and processors, respectively. Similarly, 64.9 % of the reported egg buyers accounted for individual consumers/fellow farmers, and the remaining 35.1% accounted for aggregators, wholesalers and retailers. The majority of chicken produced at the smallholder level was sold to local consumers or fellow producers in the local market.

Figure 8: Proportion of live chickens and eggs buyers reported by smallholders.



Source: ACGG Market Survey

The value of sale proceeds generated from poultry products marketing depends not only on households' decisions to participate in marketing but also on the intensity of participation. The intensity of their participation also directly affects productivity and the amount of total production (Abeykoon et al., 2013, Akidi et al., 2018). Table 8 presents an overall summary of the average number of live chickens and eggs sold in a year and month, respectively. Sampled respondents in the study areas sold an average of 11 live chickens in a year, where most of the chickens were sold to local consumers or fellow farmers. As indicated above, some producers get foundation stock from fellow producers in the same locality. The average number of eggs sold per month was about 13, with a minimum of zero and a maximum of 90. Most producers who sold more eggs and live chickens had large flock sizes and/or improved breed chickens.

Table 8: Total quantity of live chickens sold (year) and eggs sold (month)

		Average quantity sold			
Type of product	Type of buyers	Mean	SD	Min	Max
Live chickens (year)	Consumers/fellow farmers	7.9	13.4	0.0	88.0
	Traders/aggregators	2.9	11.0	0.0	90.0
	Total	10.7	16.6	0.0	90.0
Eggs (month)	Consumers/fellow farmers	8.2	20.1	0.0	90.0
	Traders/aggregators	4.9	17.4	0.0	90.0
	Total	13.2	25.0	0.0	90.0

SD=standard deviation; Min=minimum; Max=maximum

When we disaggregate the types of live chickens sold by age and type of chickens, the proportion of households who sold local cocks was greater than households who sold other types of chicken. Of the total producers who sold live chickens, about 47.3% sold local cocks (Table 9). Next to local cocks, a higher number of producers sold improved cockerels and local hens. Very few producers sold improved hens and local pullets. The average selling prices of different chicken types are summarized using the reported selling prices (Table 9). The average selling price for improved cockerel was NGN2,788.0 per chicken, significantly higher than the average price for local cocks (NGN1,901.1). Higher prices for improved cocks could be associated with the higher body weight and large body size of these breeds. According to sampled respondents, dual-purpose improved cockerels' body weight and body size are significantly higher than those of local cocks. As a result, improved cockerels usually fetch higher market prices. Similarly, compared to local hens,

improved hens fetched higher prices in the local market that could also be associated with higher egg productivity and body size of improved hens, as explained by sampled respondents.

Table 9: Average selling prices of different chicken types sold by smallholders

	Average price (NGN/chicken)					
Type of chicken	Mean	SD	Median	Min	Max	Participants (%)
Cock–local	1,901.1	802.0	1,800	500	3,500	47.3
Cock–improved	2,788.0	1,049.6	3,000	300	4,000	26.3
Hen–local	1,761.5	724.0	1,700	700	3,000	13.7
Hen–improved	2,500.0	1,275.7	3,000	400	4,000	9.4
Pullet–local	433.3	288.7	600	100	600	3.1

SD=standard deviation; Min=minimum; Max=maximum

Unlike live chickens, the price of local-breed eggs was higher than the price of improved-breed eggs (Table 10). The average reported price for local-breed eggs was 222% than improved-breed eggs. According to sampled respondents, there is a high demand for local-breed eggs than improved-breed eggs due to their use for various purposes in addition to consumption. Despite the low egg productivity of local breed chicken, higher egg prices can be an excellent incentive to keep these breeds under smallholder management conditions. Empirical research indicates the important role of poultry products' prices in production decisions and market participation(Akidi et al., 2018). An unreasonable price can give producers a negative incentive and lead to a lower level of production and marketing participation.

Table 10: Average prices of local and improved breed eggs

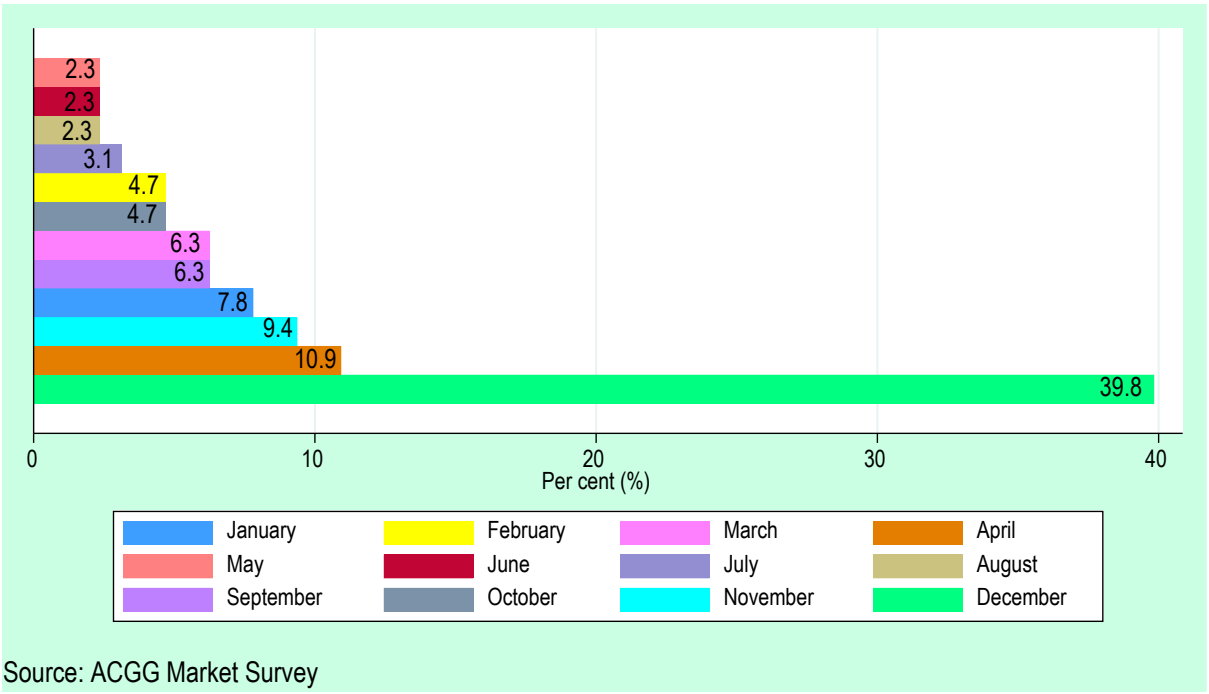
Type of egg	Mean	SD	Median	Min	Max
Local	72.4	47.8	50	20	200
Improved	32.6	9.7	30	15	50

SD=standard deviation; Min=minimum; Max=maximum

4.4.3 Seasonality of poultry products marketing

In most developing countries, the consumption of poultry products, especially meat, is highly seasonal (Ramdurg et al., 2010). We asked sampled respondents the months when the live chicken was sold in the previous 12 months. This helps to understand the seasonal variability in the marketing of poultry products. Accordingly, from the total reported sale, the largest proportion of sales were conducted in December (39.8%), followed by April (10.9%) (Figure 9). In these two months, the demand for poultry products is exceptionally high due to the main holidays' celebrations of Christmas and Easter. On the other hand, a lower proportion of live chicken selling was reported in May and June. Consumption of poultry products seems significantly higher in annual holidays or festival seasons than in other seasons. Seasonal variation in poultry products marketing affects the price of inputs and farmers' decisions for production. Some of the sampled respondents who raised improved cockerels reported that they usually align their production activities with festival seasons. Some smallholder producers reported their experience of contract-based production with individual consumers or hotel/restaurants in different seasons. Higher seasonal variability in consumption of poultry products suggests enhancing smallholder access to better market opportunities through market linkages and value additions.

Figure 9: Proportion of live chickens selling months reported by smallholders.

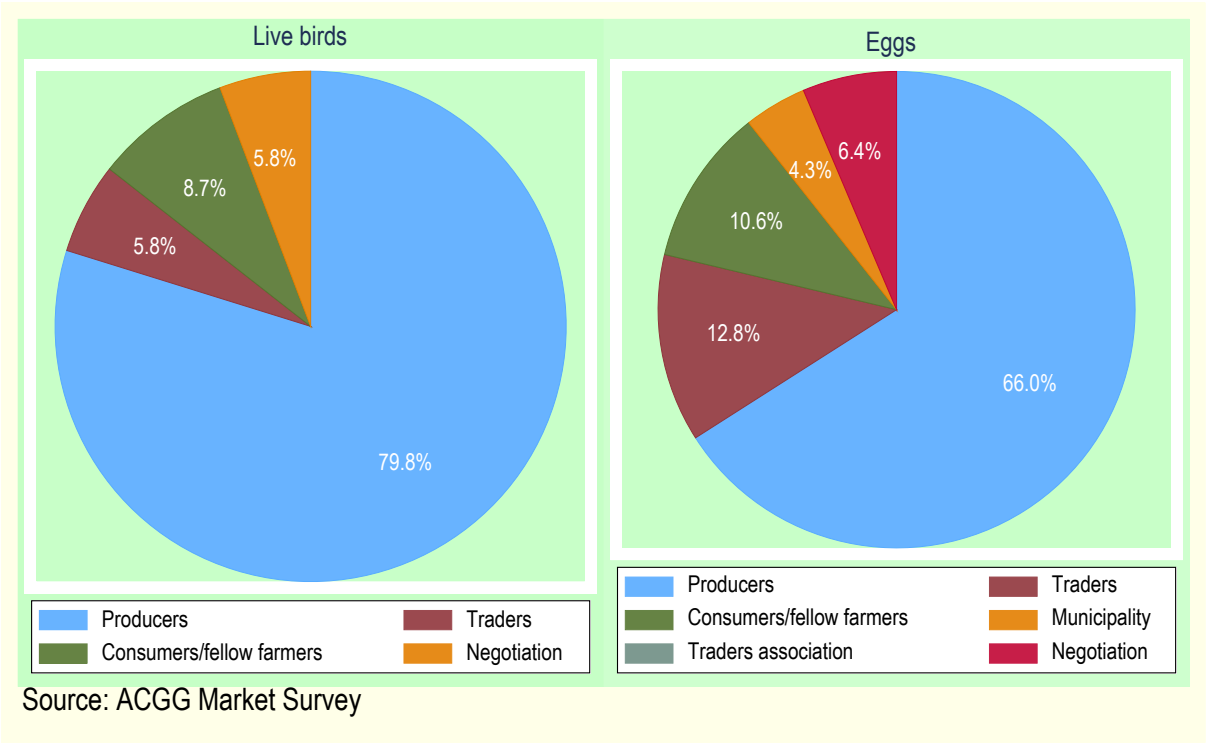


Source: ACGG Market Survey

4.4.4 Price determination of live chicken and eggs

Small-scale agricultural producers in developing countries are usually believed to receive unfair prices during the marketing of their products. This could be associated with price formation, access to market and market information mechanisms. Hence, a better understanding of the price formation mechanism significantly influences policy formulation related to agricultural product marketing. During our assessment, we asked producers about the price determination process of live chickens and eggs. Accordingly, most of the smallholder producers indicated the role of different actors during price formation. Producers had the highest role in live chickens and eggs price determination, followed by consumers and negotiation between the sellers and buyers (Figure 10). In some areas, aggregators and traders also had a significant role in price determination. Even though producers may initially quote the selling price, most respondents explained the final selling price is reached through bargaining. But producers bargaining power is constrained by their access to market information and the institutional and economic environment. Due to limited access to market information and limited marketing opportunities, smallholder producers usually have lower bargaining power. Empirical findings suggest that small-scale producers' bargaining power can be improved by building their capacity and organizing them to collectively act during the marketing of inputs and outputs (Kamdem et al., 2009, Courtois and Subervie, 2015).

Figure 10: Proportion of marketing actors who determine the price of live chickens.



4.4.5 Live chickens and eggs buying criteria

The price of poultry products depends on some quality attributes. Usually, consumers have a specific preference for different poultry products. We asked sampled respondents to list the three essential criteria their buyers use during the price formation mechanism. A summary of the responses is presented in Table 11. From the total respondents who sold eggs in the previous 12 months, about 91.7% said that egg size was the critical criteria buyers use to determine the price of eggs. Next to egg size, type of breed was the second main criteria reported by producers. Most respondents indicated large size and brown eggs are preferable to individual consumers than other types. A few producers also noted other quality attributes such as yolk colour, eggshell texture and eggshell colour as essential buyers' criteria.

Similarly, most producers (89.6%) reported the body size or bodyweight of chickens as the most important criteria to fix the price of live chickens. Next to body weight, the health status of chickens and sex of chickens were the other two important buyers' criteria to determine the price. Furthermore, some producers reported the type of breed and plumage colour as the other essential buying criteria. The buying criteria reported by producers suggest the need for aligning research and extension strategies to maximize both producers and consumers welfare.

Table 11: Major buyers' criteria of live chickens and eggs reported by smallholders

Eggs (N=36)		Live chickens (N=67)	
Criteria	Per cent of cases (%)	Criteria	Per cent of cases (%)
Type of breed	41.67	Type of breed	26.9
Egg size	91.67	Sex of chickens	38.8
Shell colour	13.9	Weight/body size	89.6
Egg shell	8.3	Plumage colour	17.9
Yolk colour	25.0	Health status	53.7

4.5. Coordination and collective action

Coordination of farmers with other value chain actors, their collective action with other fellow farmers, and membership in farmers' associations substantially contribute to enhancing the sector's production and productivity. We asked sampled respondents if they had any production or marketing agreement with input suppliers or output buyers in the previous 12 months. Accordingly, 89.5% reported they did not have any production agreement over the last 12 months (Table 12). Only a few indicated their engagement in production agreements mainly to supply live chickens for a special ceremony or holiday consumption. Limited vertical coordination with input suppliers or buyers' leads producers to higher marketing costs to purchase inputs or sell products. Producers' coordination with input suppliers such as vaccination and drug suppliers may also help access quality services.

The proportion of producers who participated in collective action and production agreements was also very low. Among others, in our context, collective action refers to group actions to purchase inputs such as feed and vaccines, group marketing and knowledge or information sharing on production and marketing. In the previous 12 months, only 15.8% and 10.5% of the total respondents participated in collective action and production agreements, respectively. The proportion of producers who participated in collective action was higher than producers who participated in the production agreements. Moreover, compared to collective action and production agreements, a higher proportion of producers (24.2%) were members of poultry production or marketing associations. Farmers' engagement in production agreements, collective action and poultry associations is an excellent strategy to enhance the competitiveness and efficiency of the value chain. Various empirical studies in Africa and other developing countries have also documented the role of farmers' organizations and collective actions to enhance members' access to factor and output markets (Barrett, 2008, Hellin et al., 2009, Kaganzi et al., 2009, Gyau et al., 2014).

Table 12: Smallholder producers' coordination and vertical integration

	Number of producers	
Type of engagement	Yes (%)	No (%)
Collective action	15.79	84.21
Membership in poultry association	24.21	75.79
Production agreement	10.50	89.50

SD=standard deviation; Min=minimum; Max=maximum

The lower level of smallholder producer's vertical and horizontal coordination suggests the need for research and development efforts in this aspect. For widespread dissemination of technologies and sustainable adoption, organizing farmers in groups and associations would significantly enhance efficiencies, reduce costs and risks, and create economies of scale. Research and development efforts must integrate value chain coordination as a vital component to fully exploit opportunities and minimize production and marketing constraints.

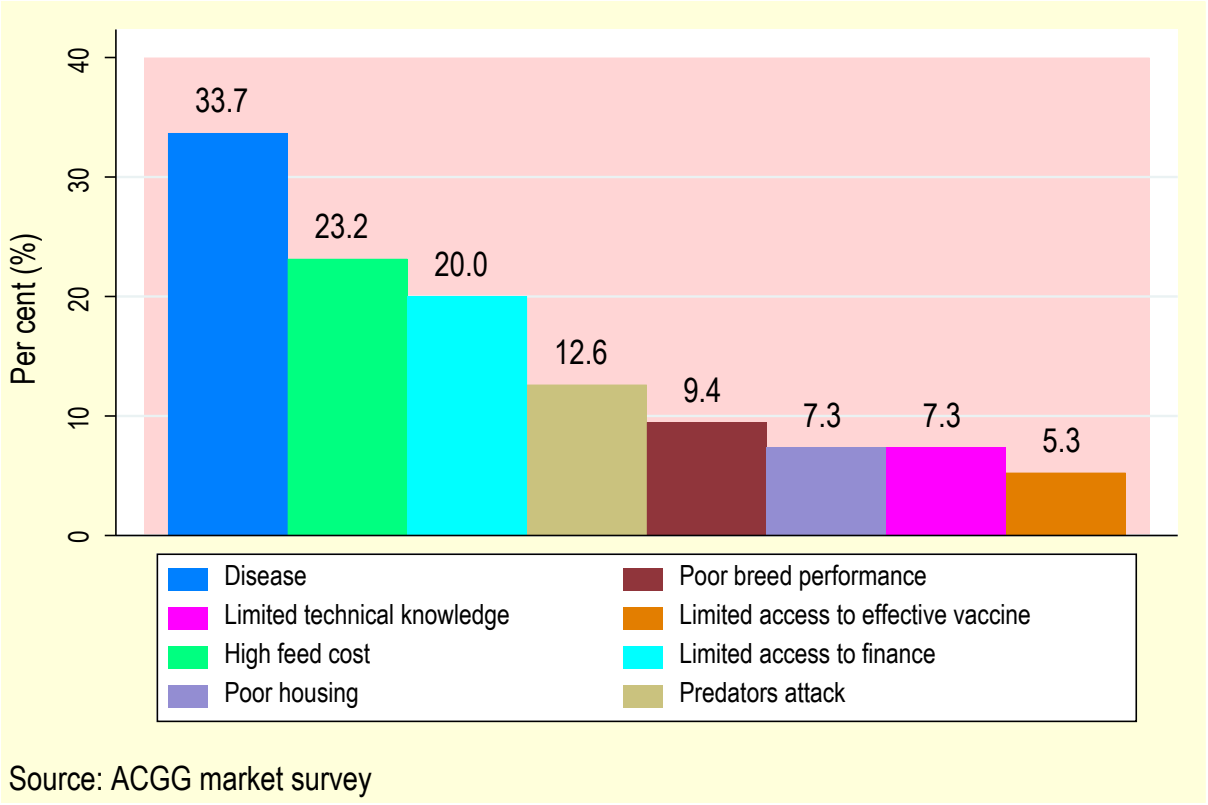
4.6 Major challenges and opportunities in smallholder chicken production

The low level of smallholder chicken production and productivity could be attributed to different production and marketing constraints. To understand smallholder producers' current perception of challenges and opportunities in chicken production, we asked sampled respondents to explain main constraints, possible solutions, available opportunities, and policy options to address constraints and exploit opportunities. The following section summarizes reported production and marketing constraints, suggested solutions and available opportunities.

4.6.1 Production constraints

Producers listed eight critical constraints related to chicken production in their local areas. The overall share of these constraints is summarized in Figure 11. Among these constraints, disease (33.7%), high feed cost (23.2%), limited access to finance (20.0%) are the first, second and third most important constraints, respectively. Most of the producers reported high disease prevalence and disease outbreaks as their main challenges for sustainable production. As indicated above, according to sampled respondents, despite their repeated use of vaccine and disease treatment drugs, most of them experienced the loss of chicks. These may be associated with the efficacy of the vaccines and the quality of drugs used. Producers explained that high feed cost and limited access to finance had restricted their interest in increasing poultry flock sizes. Predators' attacks and the low performance of breeds were among the major constraints reported by smallholder producers. Producers feel that the productivity of available breeds is extremely low, which could be associated with poor genetics and inadequate management, such as limited feed and health services, poor housing, and limited technical knowledge of producers.

Figure 11: Major production-related constraints raised by producers.

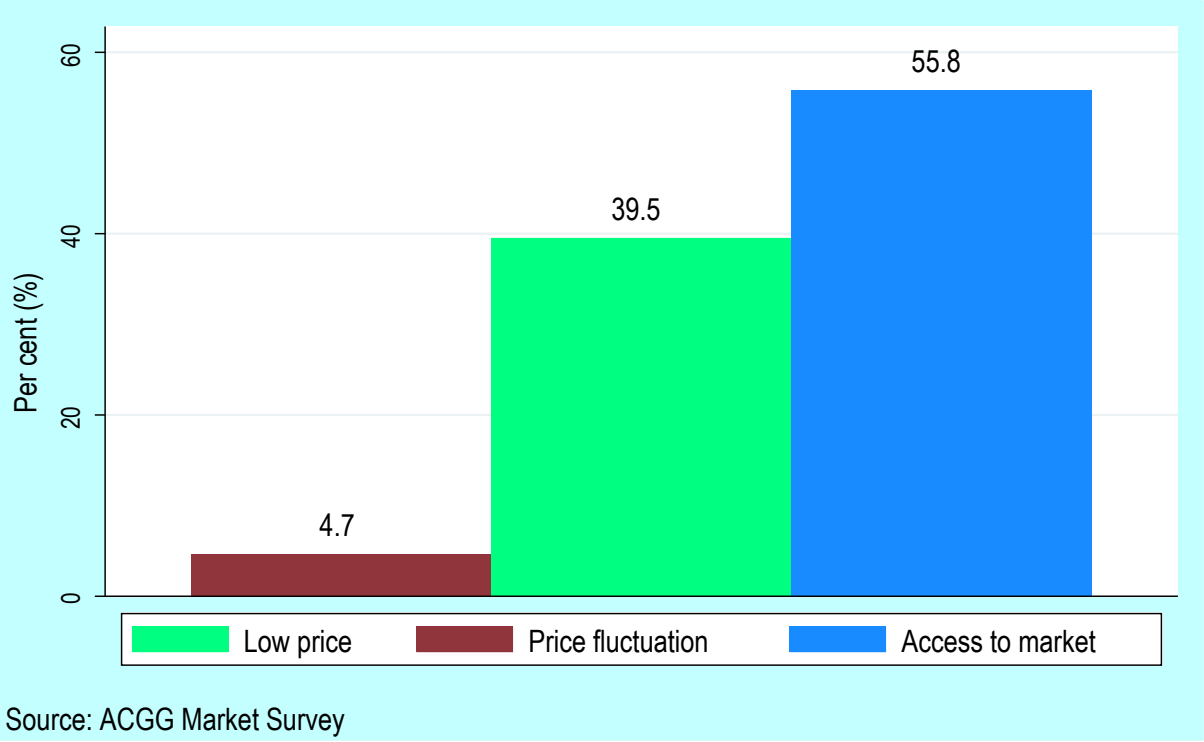


Source: ACGG market survey

4.6.2 Marketing constraints

Some of the producers raised three types of marketing constraints. Figure 12 presents the relative proportion or share of the reported marketing constraints reported by sampled respondents. Access to better marketing opportunities (55.8%) and lower market price (39.5%) were the first and second most important constraints raised by sampled producers. Most smallholder producers explained that available markets for live chickens and eggs were not adequate. Due to limited market opportunities, usually, they sell products at a lower price. Most producers feel that the prices of live chickens and eggs in local markets were lower than what they would expect based on the cost of production. Some of them also reported price fluctuation as the other important marketing constraint. As indicated above, this could be associated with the seasonal consumption patterns of poultry products and limited access to primary markets.

Figure 12: major marketing-related constraints raised by producers.



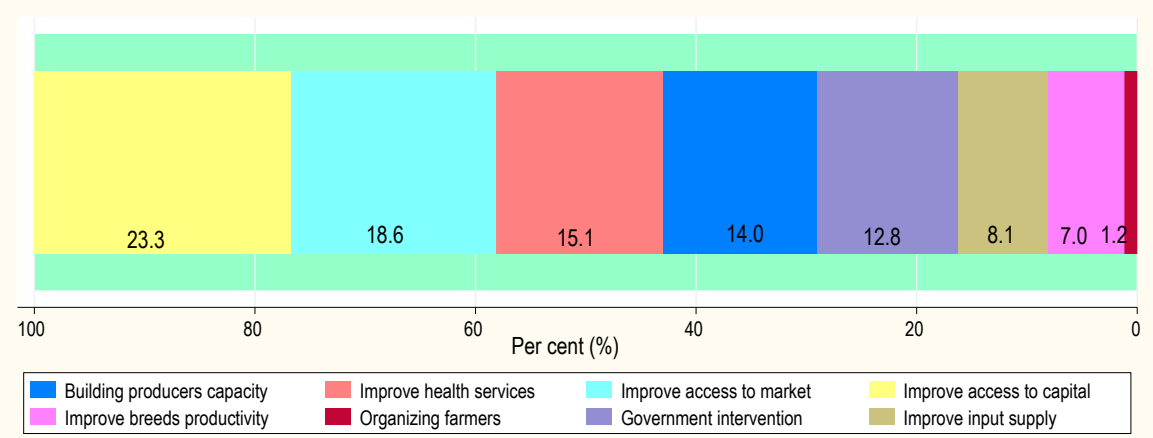
Source: ACGG Market Survey

The presence of market-related challenges highlights the need for integrating market interventions with production and productivity-enhancing interventions. Production and productivity gains result in positive economic and social gains if there is a better market for products. Due to additional investment and inputs costs associated with the improved breeds, farmers' gains from improved breeds adoption will be realized if there is a good market for the products (Barrett and Mutambatsere, 2008). Barrett and Mutambatsere (2008) suggested that lower price and price fluctuation in the poultry market would be effectively resolved by getting price and institutions right. Therefore, governments in developing countries should establish the appropriate institutions that make the price of agricultural products right.

4.6.3 Possible solution suggested by producers

After discussing primary production and marketing constraints, we asked producers to suggest viable solutions for the main challenges raised above. This helps to understand their proposed solutions to the reported challenges and develop inclusive, pragmatic and localized solutions in the future. The key proposed solutions suggested by smallholder producers were improving producers' access to finance, improving access to the market, improving health services, building the capacity of producers, enhancing input supply, improving the productivity of available breeds, and organizing farmers (Figure 13). From the total responses, improving access to finance and market accounted for 23.3% and 18.6% of suggested solutions, respectively.

Figure 13: Proportion of major solutions suggested by the producers.



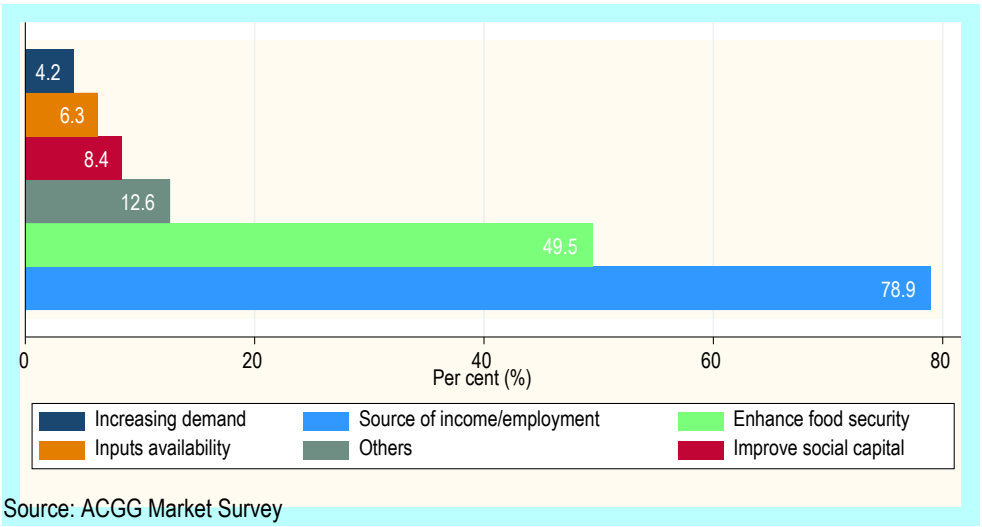
Source: ACGG Market Survey

4.6.4 Possible opportunities in smallholder chicken production

We asked producers to indicate the three most important opportunities or benefits they experienced from their smallholder chicken production in the previous 12 months. Most of the producers had a strong and positive perception of the contribution of smallholder chicken production to household livelihoods. The largest number of producers (78.9%) highlighted that smallholder chicken production is a reliable source of income or employment opportunities in their areas (Figure 14). As indicated above, according to producers, they used the income generated to pay children's school fees and cover household medical expenses. Some smallholder producers consider chicken production a source of income to fulfil households' emergency or unexpected needs. When they face emergency needs, they can quickly sell chicken in the village or nearby markets.

Enhancing household food and nutritional security was the second important benefit realized by smallholder producers. About half (49.5%) of sampled respondents explained that smallholder chicken production has improved households' food and nutritional security either from direct consumption of eggs and meat or purchase of other food items using the income generated from the sale proceeds. Furthermore, increasing social networks, availability of input for better production, and increasing demand for products were other vital opportunities. According to some producers, engagement in smallholder poultry production enhances their social capital by creating opportunities to connect with different value chain actors, either buy inputs or sell outputs.

Figure 14: Major important opportunities reported by smallholder producers.



Source: ACGG Market Survey

4.7 Economic contribution of TAIBs-based production

Traditionally, smallholder chicken production has been known by the low input and low output production system. However, this assessment's findings indicate that most smallholder producers use different inputs such as feed, vaccination, and housing for both local and improved chicken breeds. Therefore, it is crucial to assess the benefits and costs of using various inputs such as improved breeds, feed, vaccines and better poultry management practices. We used the reported value of inputs and outputs in the previous 12 months to estimate the costs and benefits of different production practices. We focused on assessing the economic contribution of TAIBs introduced by the ACGG project interventions. The assessment aimed at evaluating the feasibility of adopting these breeds under smallholder management conditions.

We applied partial budget analysis to estimate the economic gain using dual-purpose TAIBs over existing indigenous breeds-based production. The main aim of the partial budget analysis was to evaluate the additional income generated from adopting TAIBs with minimum change in management over the present local breeds-based extensive scavenging production system. The basis for the partial budget analysis was the ACGG project intervention in various parts of the country. During this intervention, which involved on-farm and on-station experiments, a locally adapted dual-purpose improved chicken breed was distributed to smallholder producers in different parts of the country, and farmers preferred breeds were identified. The distribution was made by public-private partnerships where the private hatcheries produced the DOCs and supplied them to mother unit farms to raise the chicks for certain days. During the brooding stage, the mother unit farms raised the chicks with balanced feed and necessary vaccination and treatments. Activities conducted by mother units are difficult to undertake at the individual smallholder producer level. After 45 days, the mother units distributed the chicks to smallholder producers through appointed agents.

In the partial budget analysis, we adopted two scenarios: the base scenario, the existing production system, and the alternative scenario, the proposed or preferred scenario promoted by ACGG intervention. In our context, the existing indigenous breeds-based extensive scavenging was the base scenario, while the TAIBs-based semi-intensive production was the alternative scenario. The two scenarios were defined based on FAO poultry production system classification in developing countries (FAO, 2014). The analysis considered the following three main assumptions: change in breed type, flock size and moderate change in management. The change in breeds refers to shifting local breeds to TAIBs; the ACGG project disseminated the breeds, and they are currently kept by some smallholder producers in the sampled market sheds. The change in flock size refers to increasing the average extensive scavenging flock size (5–49) to the average flock size in semi-intensive production (50–200). The assumption on minimum change in management refers to moderate change in feeding, vaccination and housing associated with the shift in breeds and production systems. We call the change in management minimum as most of the sampled smallholder producers were also using purchased feed and vaccination for the local breeds. The overall production cycle for this analysis was assumed to be 18 months.

For the alternative scenario, we considered two flock size situations, 50 and 75. For the 50 flock size situation, producers are expected to keep 50 dual-purpose chickens when 50% are pullets and the remaining 50% are cockerels. Assuming three months growth period for cockerels and two to three weeks for cleaning and replacement preparation, the producers would have at least five batches of cockerel production in 18 months. Hence, the total cockerels produced during the entire production cycle would be 125. We generated the data for TAIBs' egg production from reported values of eggs produced by these breeds in the previous 12 months. It is assumed that the layers start laying eggs on average after five months of arriving at the farm. This would result in about 13 months of egg-laying duration. For the 75-flock size scenario, we assumed increasing the number of layers from 25 to 50 and keeping the number of cockerels' production the same. Changing the flock sizes based on available resources is one of the main advantages of dual-purpose breeds-based production.

Based on the above-reported values, we assumed the producers start with 12 hens and two cocks for the extensive scavenging production scenario. It is a more relaxed assumption as most smallholder producers would start with fewer hens, as shown in Table 2. Based on our assessment, a hen lays an average number of 12 eggs per clutch for four clutches in a year, which gives about 48 eggs per year. We assumed that, from the 12 hens, four of them are used for brooding and the remaining eight for egg production. The hens for brooding would have an average number of three hatches during the production cycle, with full chickens' growth to the maturity stage. The eggs set in a single brooding cycle are 11, with an average hatchability of 77.1% and a survival rate of 73.0%. Based on the estimated hatchability and survival rate, a broody can produce seven chicks per cycle, resulting in 21 chicks in the entire production period. The total number of chickens produced from the four broody hens in 18 months would be 84. The values of egg and live chicken produced in both scenarios were estimated using the market price data generated from the survey.

Figures 15 and 16 present summaries of the total gain, total loss and net change in income for 50 and 75 flock size scenarios. In the 50-flock size scenario, the average net gain in income is NGN297,300. This shows that smallholder producers can generate an additional NGN297,300 income by shifting from extensive scavenging to TAIBs-based semi-intensive production. Similarly, if the producers increase their flock size to 75, their average net gain in income would increase to NGN460,700 (Figure 16). The average growth in gross profit would be 423% and 390% under the 50 and 75 flock size scenarios, respectively. The estimated net gain in income is highly significant at the smallholder level of production. This shows TAIBs-based production's contribution to enhancing smallholder chicken production and productivity with a modest change in management and inputs used.

Figure 15: Summary of partial budget analysis for flock size 50.

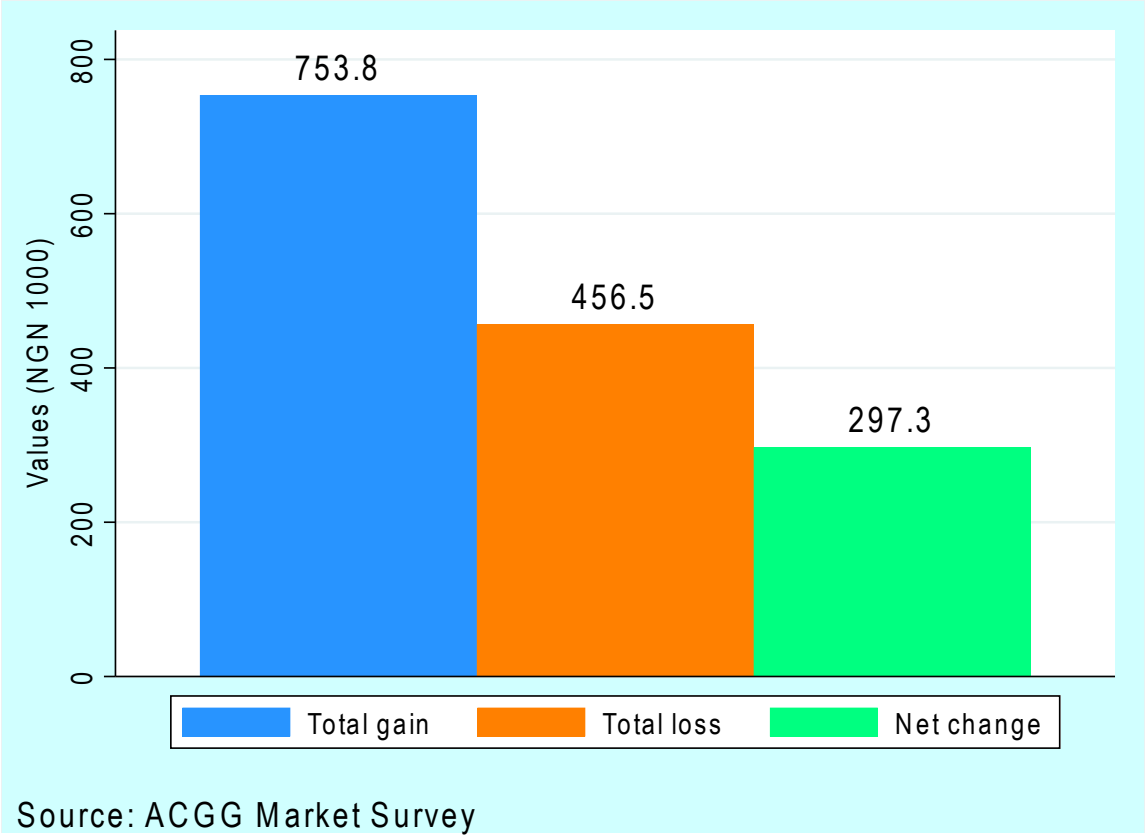
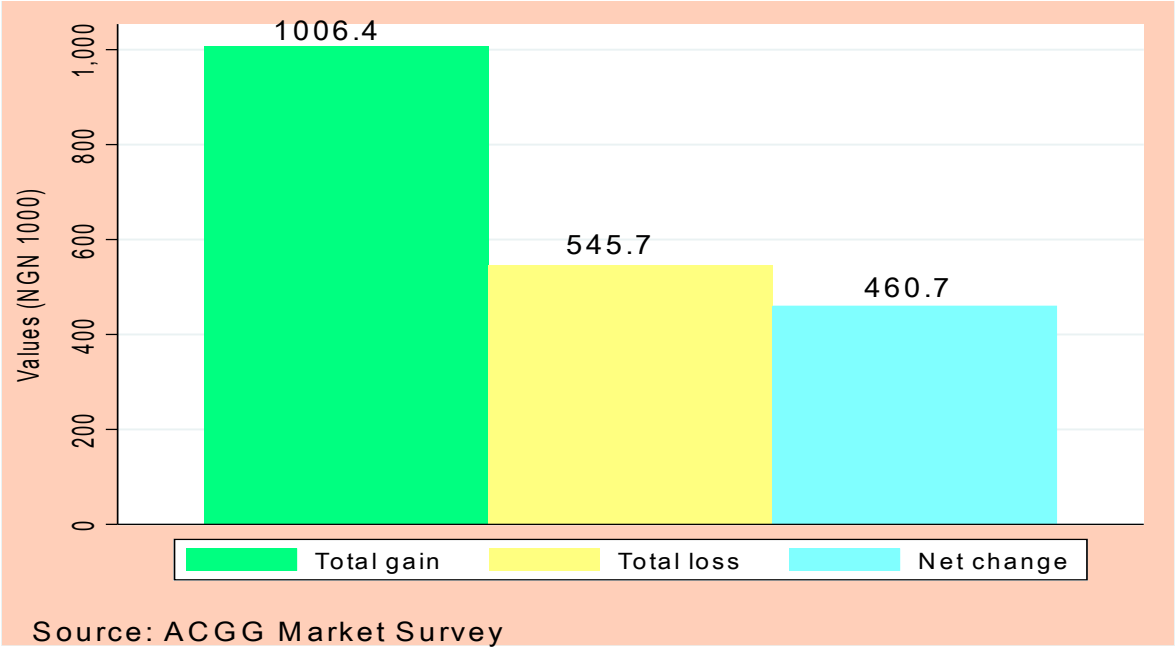
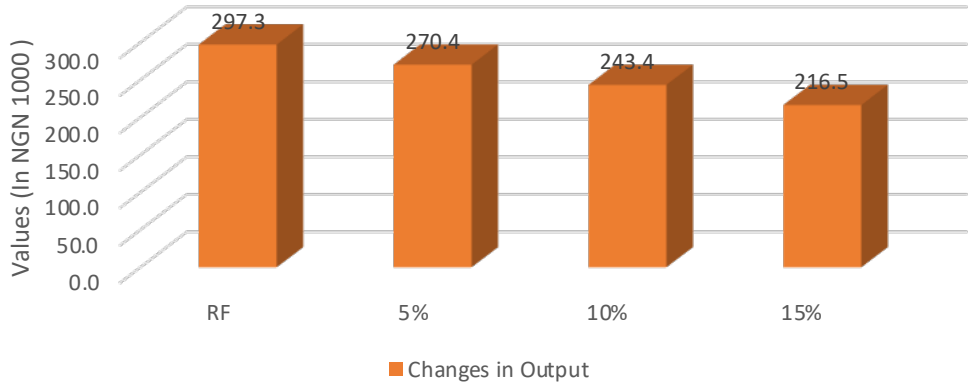


Figure 16: Summary of partial budget analysis for flock size 75.



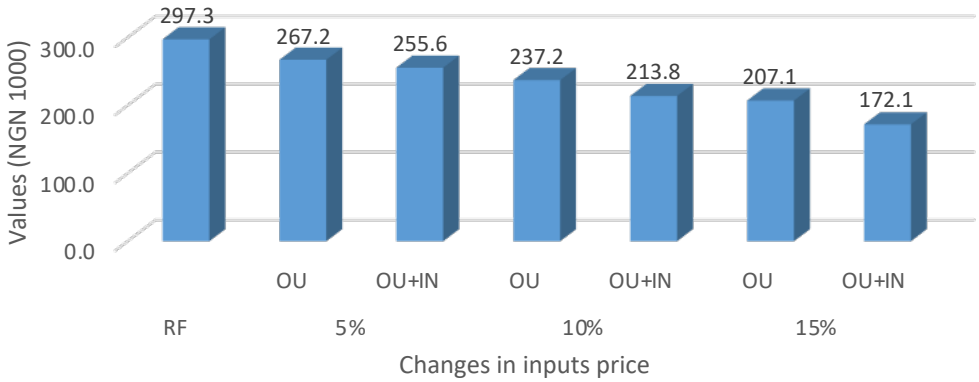
Production and marketing risks associated with agricultural activities are inevitable (Ogada et al., 2010, Komarek et al., 2020). Mortality or loss of birds at different growth stages and decreased productivity are the leading causes of decreased production. The overall return from poultry production can reduce due to lower egg and live bird productivity. Considering diverse risk factors, we conducted a sensitivity analysis using indicators that significantly affect the outcomes of the alternative scenario (Finger and Schmid, 2008). These are the sensitivity of the change in net income gains due to decreased egg productivity and loss of chicken due to mortality and other factors. For this analysis, we used the 50-birds size scenario. Three production loss scenarios (5%, 10% and 15%) are compared with the normal or reference category (RF), the estimated value under the normal production condition. A 5% change in production refers to a simultaneous reduction in 5% egg productivity and a 5% loss of cockerels due to mortality. A 10% change in production refers to a simultaneous reduction in 10% egg productivity and a 10% loss of cockerels due to mortality. Results from the sensitivity analysis show that the net gain in income in all scenarios remains positive and significant. For instance, in the 5% change scenario, the additional net gain in income is slightly reduced from NGN297,300 to NGN270,400, which is about a 9% decrease in a net gain in income. The estimated results from the three-change scenarios highlighted that TAIBs-based production still generates a positive net gain in income (Figure 17). This shows that shifting the production system to TAIBs-based production is robust under major unexpected production shocks.

Figure 17: Sensitivity of change in net income due to a decrease in production.



The other possible cause of changes in net income gain is an increase in inputs price and a fall in output prices. This may be related to marketing risks, and as the production risk, we evaluated the effect of the marketing risks using the 50-birds flock scenario. In this case, we considered two different scenarios: a decrease in output price only and a simultaneous decrease in output price and an increase in input price. Figure 18 summarizes the estimated change in net income during 5%, 10% and 15% change scenarios. Like the 50-birds scenario, the net gain in income remains positive and significant. For instance, during a 5% change scenario, a 5% decrease in output prices (OU) reduces the net gain in income from NGN297,300 to NGN267,200. In the second situation of this scenario, a 5% decrease in output price and a 5% rise in input price reduce the net gain in income from NGN297,300 to NGN255,600. Although the likelihood of observing both an increase in input price and a decrease in output price is unlikely, the estimated gains in income even in this worst scenario remain positive. This demonstrates that adopting dual-purpose TAIBs could generate modest income during unexpected price shocks, which could be an excellent incentive to adopt the production system sustainably.

Figure 18: Sensitivity of change in net income due to price change.



OU=decrease in output price; IN=increase in input price

The additional income generated from shifting the production system is more than enough to send more children to schools, cover medical expenses, purchase other inputs to support agricultural activities (i.e.crop production) and buy other livestock species such as sheep and goats. This helps resource-poor and landless households to build assets and improve their livelihoods. Furthermore, as indicated by sample respondents, increased production would significantly improve household food and nutritional security through direct consumption of meat and eggs or other food items.

The other most crucial indicator of the profitability of adopting improved technologies is the marginal rate of return (MRR). This indicator would help to measure the net return from additional costs invested in shifting the production system. In this analysis, MRR is the ratio of change in net income/gain (marginal benefits) from shifting extensive scavenging to semi-intensive production over the change in cost (marginal cost) of production associated with the shift. It measures the net return from the added capital invested in shifting the production system. In the 50-birds scenario, the MRR is 366.9%, which is very high compared with any minimum acceptable rate of return if a farmer invests the money in another similar business or deposits it in the bank. The MRR can be interpreted as one NGN invested in TAIBs-based semi-intensive production would generate NGN3.7 as a return. Compared with the optimal rate of return (100%), which is mostly recommended for agricultural technologies adoption, the estimated MRR is very high.

In conclusion, despite widespread interventions that aim to improve smallholder chicken production and productivity, observed gain in production and productivity has been low in the previous decades. This could be associated with a lack of integrated and comprehensive interventions that would address the country's dynamic and complex smallholder chicken production and marketing constraints. Hence, strategic efforts to improve smallholder chicken productivity should adopt holistic approaches, including genetic improvement and delivery, access to low-cost feed and health services, enhanced management, capacity development, and improved access to finance and markets. Given their limited access to inputs and institutions and a significant gap in productivity of local breeds, introducing

yield-enhancing innovations has multiple benefits. One of the best strategies would be introducing dual-purpose TAIBs. This helps producers to maximize their consumption and profit earning objectives. Findings from the above economic and marketing performance indicators suggest that TAIBs are among the best options to enhance the productivity of smallholder chickens in the country. Due to their suitability for a semi-intensive production system and better resistance to infections, TAIBs have a pertinent role in transforming traditional smallholder chicken production in the country. For sustainable production, farmers' management capacity and access to markets and finance should be enhanced. Moreover, smallholder producers must be organized to exploit opportunities available through collective actions during production and marketing decisions.

5. Economic performance of mother units

Efforts to transform local breeds-based traditional smallholder chicken production to TAIBs production would not be successful without a sustainable delivery of replacement chicks. Lessons from the ACGG project show that access to replacement stock is the main constraint to shifting traditional smallholder chicken production to intensive or semi-intensive production systems. Introducing mother unit farms is one of the emerging strategies promoted by research and development organizations, including ILRI, to address this challenge. These farms would work with commercial hatcheries to raise and disseminate healthy and vigorous chicks to smallholder farmers. They receive day-old chicks from large-scale hatcheries, raise them for specific days and sell to smallholder producers or small-scale commercial farms. These farms have a significant contribution as they handle the chicks at an early stage when the birds need intensive care and a management system. This helps to reduce the high chick mortality rate that farmers usually experience at the early growth stage and enhance the overall farm production and productivity. In this brief market chain assessment, we interviewed sampled mother unit farms to understand the cost and benefits of production and their contribution to the overall development of the traditional smallholder production system. In the following subsections, we present major findings of the assessment.

5.1 Average level of production

The profitability of mother unit farms depends on their production and productivity levels and access to the market. Data on flock size and average number of production cycles were collected to highlight the current production level in sampled mother unit farms. Table 13 illustrates a summary of the reported production level. Sampled mother unit farms in the selected market sheds could produce an average of seven batches or cycles in a year, with a minimum of five and a maximum of 12 batches. The chicks' average duration on the farms was about 36 days or five weeks, with a median of 42 days. Sampled respondents raised about 722 chicks per batch, with a minimum of 500 and a maximum of 2,000 chicks. During the assessment, sampled mother unit farms grew Noiler, ISA White, ISA Brown and other TAIBs.

Table 13: Number of production cycles and level of production in mother unit

Indicators	Mean	SD	Median	Min	Max
Number of batches/year	7.1	2.3	6.0	5.0	12.0
Total number of days/batch	35.9	8.8	42.0	20.0	42.0
Number of chicks/batch	721.4	621.7	500.0	200.0	2,000.0

SD=standard deviation; Min=minimum; Max=maximum

5.2 Cost of production

The cost of production for mother unit farms was recorded based on operators' recall or from their records. Like any other commercial farm, mother unit farms have different variable and fixed costs. A summary of the reported costs and values indicate that variable expenses account for the largest share of production costs. Types and estimated values of different variables cost items used in the previous production cycle are summarized in Table 14. The cost of DOCs and feed accounted for 43.8% and 31.9% of the total variable costs. The remaining 24.3% accounted for other variable costs such as hired labour, vaccination, antibiotics, transport and brooding. Some farms used their own or family labour, while others used hired labour. The average variable cost of production was NGN330.8 per chick, with a minimum of NGN156.1 and a maximum of NGN597.4 per chick. The higher standard deviation of variable costs among farms could be associated with the type of breeds, location of the farm and brooding duration.

Table 14: Type and value of variable costs used in mother unit

	Average cost of production (NGN/chicken/batch)				
Type of inputs	Mean	SD	Min	Max	Share (%)
DOCs	144.9	92.7	25.0	252.0	43.8
Starter feed	105.5	54.1	49.0	216.0	31.9
Litter	5.0	1.9	2.5	7.5	1.5
Brooding	8.3	7.0	0.3	17.5	2.5
Electricity	3.0	0.9	2.4	4.0	0.9
Vaccination	11.8	4.7	6.0	18.0	3.6
Antibiotics	16.9	10.2	5.4	30.0	5.1
Transport	11.7	6.4	4.3	21.5	3.5
Water	4.8	3.2	1.5	9.0	1.4
Hired wage	26.0	22.6	0.0	66.7	7.8
Miscellaneous	1.6	2.7	0.0	6.0	0.5
Total	330.8	148.2	156.1	597.4	100.0

SD=standard deviation; Min=minimum; Max=maximum

Table 15 presents the estimated annual variable cost of production for the reported average number of batches in a year. The average yearly cost of production ranges from NGN478,500 to NGN3,438,300 per farm, with a mean value of NGN1,455,200. As expected, this cost depends on the capacity of mother units and the number of batches the farm produced in a year.

Table 15: Estimated values of average annual variable costs

Type of inputs	Total annual cost of production (NGN1,000)			
	Mean	SD	Min	Max
DOCs	646.2	630.9	62.5	1,800.0
Starter feed	462.5	312.9	73.5	1,009.5
Litter	18.5	15.7	0.0	40.0
Brooding	49.5	73.8	1.7	210.0
Electricity	4.1	7.1	0.0	19.2
Vaccination	46.9	25.9	24.0	96.0
Antibiotics	64.4	40.8	17.5	129.9
Transport	30.1	31.9	0.0	78.0
Water	18.9	39.5	0.0	108.0
Hired wage	107.6	79.0	0.0	240.0
Miscellaneous	6.4	11.8	0.0	30.0
Total	1,455.2	1,108.8	478.5	3,438.3

SD=standard deviation; Min=minimum; Max=maximum

In addition to the above variable costs, mother unit farms have also fixed costs such as housing, feeders and drinkers. The average depreciation costs of these assets were estimated using the reported values of construction or purchase and the estimated longevity of the fixed assets. On average, mother unit farms spent NGN3.2/chicken/year for fixed assets, with a minimum of NGN0.06 and a maximum of NGN6.64/chicken/year (Table 16). A lower fixed cost per chick is associated with a higher number of productions in a year. Variability in the cost of assets could be related to the size and quality of the assets.

Table 16: Estimated depreciation cost of major fixed assets in mother units

	Average annual depreciation cost (NGN/year/chicken)			
Type of fixed asset	Mean	SD	Min	Max
House/shelter	3.05	1.70	1.19	5.00
Feeder	0.81	1.22	0.03	3.48
Drinker	0.66	1.12	0.03	3.16
Total	3.21	2.37	0.06	6.64

SD=standard deviation; Min=minimum; Max=maximum

5.3 Total value of production

Unlike smallholder chicken production, estimating the values of products for mother unit farms is straightforward. The main output in these farms are chicks and sometimes manure. We computed the average value of production using the reported number of production and selling prices. However, we adjusted the total value of chicks produced based on chicken losses due to mortality and other hazards. Therefore, the total income reflects the total number of sales values reported by the producers. According to producers, the average survival rate of the chicks was about 94.9, which indicates about 5.1% loss due to disease and other hazards (Table 17). A chick's reported average selling price was about NGN525.0 with a minimum of NGN250.0 and a maximum of NGN800.0. The difference in selling price could be associated with differences in breeds, age of chicks and farm location. Sometimes when the chicks stay a longer number of days on the farm, due to various reasons, producers set higher prices to account for additional costs incurred.

Table 17: Total annual income generated by mother units

Production indicator	Mean	SD	Min	Max
Number at starter stage	721.4	621.7	200.0	2,000.0
Total number sold	683.1	589.7	190.0	1,900.0
Survival rate (%)	94.9	2.5	90.0	97.0
Total number chicks sold	4,744.6	3,725.1	1330.0	11,400.0
Price/chick (NGN)	525.0	176.2	250.0	800.0
Total annual income (in NGN1,000)	2,394.8	2,132.4	843.8	6,283.2

SD=standard deviation; Min=minimum; Max=maximum

5.4 Estimated farm profitability

Based on the above cost and revenue data, we generated different farm profitability indicators to assess the economic viability of these farms (Table 18). On average, sampled mother units generated NGN922,500 annual net farm income, with a minimum of NGN227,100 and a maximum of NGN2,794,700. The average gross margin was 34.8%, with a minimum of 14.3% and a maximum of 45.3%. The difference in gross margin could be associated with the scale of operation and location of the farms. The estimated gross margin represents NGN100 sales; mother units generate NGN34.8 gross profit. The profitability indicators suggest these farms could generate a modest income for their operators, which shows the contribution of these farms in creating employment opportunities for youth and rural women, especially during widespread adoption of improved breeds-based production in the country.

Table 18: Gross and net farm income of mother units

	Average values			
Indicators	Mean	SD	Min	Max
Gross farm income (NGN1,000)	939.6	1055.1	231.1	2844.9
Net farm income (NGN1,000)	922.5	1040.0	227.1	2794.7
Gross margin (%)	34.8	12.2	14.3	45.3

SD=standard deviation; Min=minimum; Max=maximum

5.5 Major buyers of chicks and price determination

We asked producers about the most important chick buyers. Accordingly, sampled respondents indicated smallholder producers, small-scale commercial broiler and layer farms and marketing agents as their major buyers. In the previous 12 months, most mother unit farms sold chickens to smallholder producers, indicating a strong relationship between the mother unit and smallholder chicken producers. From the total number of chicks sold, the share of smallholder producers was 67.7%. Furthermore, we asked them about the months when they had a low or peak supply of chicks. Accordingly, September to November was reported as a peak sale/supply season and December to April as a low sale/supply season. Higher production from September to November is expected due to higher meat and egg demand in the holiday seasons (from December to April). Smallholder chicken production usually increases in this period, mainly due to increased meat consumption in the country.

Evidence on the price formation mechanism shows that the price of chicks is mainly determined by producers based on the cost of production. However, some of the producers also reported the role of market conditions in price determination. A higher supply of chicks in the market sometimes leads to lower prices. Moreover, most of the producers (57.14%) explained that the price of chicks was determined based on some grading criteria such as type of breeds,

weight or body size, health status, and physical status (e.g., absence of deformity). Healthy and vigorous chicks usually fetch better prices than others do.

5.6 Networks and collective actions

For sustainable and efficient value chain development, the role of networks and collective action is pertinent. We asked operators of mother units about production or sale agreements, membership in poultry associations and benefits obtained from the membership. Accordingly, only 28.6% of the sampled farms reported having at least one production agreement with smallholder producers and broiler farms in the previous 12 months. Other farms reported their experience in working with other value chain actors like hatcheries. About 42.9% of the respondents hold membership in poultry production and marketing-related associations. According to these producers, access to market information, linkage to new buyers, and training were some of the benefits of membership in an association.

5.7 Challenges and opportunities in mother unit farms

As an emerging business, mother unit farms usually face various challenges. During this assessment, sampled respondents reported challenges related to production and marketing activities. The most important challenges include disease from hatcheries, heat stress, limited access to DOCs, high feed cost and limited access to finance. Few of the mother units explained that they experienced high mortality of chicks after receiving them from hatcheries, and producers suspected the diseases were coming from hatcheries. Some mother units reported that access to DOCs and increasing feed prices are significant challenges in some months of the year. Additionally, others mentioned limited access to health services such as vaccination and drugs as their challenges.

To enhance the sustainability of these farms and improve their contribution to the smallholder production system, the reported challenges should be adequately addressed. Due to their essential contribution to transforming the traditional low productive system and emerging business opportunities, mother unit farms need special policy attention and support from governmental and non-governmental organizations. Mother units can also serve as a bridge to link the smallholder producers to the commercial sector and transfer better technologies and production practices. Due to their significant contribution to supply replacement stocks, the success of research and development efforts to transform traditional smallholder chicken production to improved breeds-based production is highly associated with the sustainability of these farms.

We asked mother unit operators if they have observed any opportunities in this business. Most of them reported a better source of income, source of employment, availability of market, low level of mortality as valuable opportunities in this business. Due to an increasing trend in market opportunities, some producers have also explained their plan to increase production in the coming years. Sampled mother units suggested adequate support from the governmental or non-governmental organizations to improve access to inputs (i.e. DOCs and feeds), develop their capacity and enhance access to credit services.

6. Economic performance of small-scale layer producers

6.1 Production and productivity indicators of layer farms

Commercial layer farms are among the emerging poultry farms that supply most eggs to peri-urban and urban consumers. These farms could be categorized into small-, medium-, and large-scale commercial farms. This assessment mainly focused on small-scale layer farms, which kept less than 10,000 layers. We collected data on production practices such as cost of production, main products they produce, marketing activities, and most important challenges and opportunities. Sampled layer farms kept Isa Browns, Lohmann Brown, Noiler and other breeds during this assessment. Table 19 summarizes the reported number of months before layer chicken starts laying eggs, the duration of the layers on the farm, and the average number of egg production months. During the assessment, the average number of layers kept by sampled farms was 2,984.6, with a minimum of 500 and a maximum of 7,000 layers. On average, layers start egg laying at five months, with a minimum of 4.5 and a maximum of 6 months. Producers reported they kept layers for about 22.3 months, beginning from DOCs. The average laying period was 17.2 months, with a minimum of 12.0 and a maximum of 24.0 months. Compared to the conventional commercial layer production practices, it seems that some of the sampled farms kept layers for more extended periods. This could be associated with a poor understanding of the cost and benefits of longer production duration, problems with access to replacement stock and access to a better market for spent hens.

Table 19: Egg-laying months, length of keeping and production duration

Production indicators	Mean	SD	Min	Max
The onset of egg laying (months)	5.1	0.5	4.5	6.0
Length of keeping (month)	22.3	3.7	16.5	28.8
Eggs laying duration (months)	17.2	3.9	12.0	24.0
Average number of layers	2,984.6	2,228.5	500.0	7,000.0

SD=standard deviation; Min=minimum; Max=maximum

6.2 Cost of production

6.2.1 Type and value of variable inputs

Layer production involves three cycles: chicks/brooders stage, grower stage and layers or egg-laying stage. We collected the data on the cost of production based on these three stages. The variable cost of production includes DOCs, feed, vaccination and disease treatment, antibiotics, brooding, electricity, transport, labour, water and other miscellaneous costs. The feed cost includes a starter, grower and layer feed. Table 20 presents a summary of the costs

associated with the whole production cycle. Feed cost accounted for the highest proportion (87.7%) of variable costs. Compared to similar studies, this cost looks very high due to the longer production duration reported by sampled layer farms. Next to the feed cost, hired wage and DOCs accounted for the second and third largest share, respectively. The average feed expense per layer for one production cycle was NGN5,396.2, with a minimum of NGN1,735 and a maximum of NGN10,620.0. The average total variable cost of production was NGN6,154.61 per layer, with a minimum of NGN2,270.8 and a maximum of NGN11,814.93 per layer. Significant variability in feed and total variable cost could be associated with a difference in duration of production, type of breed, farm location and type of management.

Table 20: Types and values of variable costs reported by layer farms (NGN/layer)

	Values in NGN/layer				
Type of inputs	Mean	SD	Min	Max	Share (%)
DOCs	309.23	284.06	180.00	1250.00	5.02
Feed	5396.16	2566.92	1735.00	10620.00	87.68
Litter/wood shave	3.19	3.99	0.21	10.00	0.05
Brooding	7.13	4.66	2.21	15.00	0.12
Electricity	47.45	52.65	10.18	165.00	0.77
Vaccination	26.54	26.63	3.75	100.00	0.43
Antibiotics	26.33	31.56	0.93	100.00	0.43
Transport	40.04	37.92	0.71	110.40	0.65
Water	11.01	14.49	0.00	46.00	0.18
Hired wage	311.69	236.24	0.00	828.00	5.06
Miscellaneous	0.73	1.48	0.00	5.00	0.01
Total variable cost	6154.61	2620.02	2270.80	11814.93	100.00

SD=standard deviation; Min=minimum; Max=maximum

6.2.2 Annual depreciation cost of fixed assets in layer farms

Annual depreciation cost of main fixed assets such as housing, cages, feeder, and drinkers was estimated using the farm owners' reported values of purchase/construction. A summary of the estimated values is presented in Table 21. The overall estimated depreciation costs for poultry shed, feeder and drinker were NGN176.0, NGN 4.15 and NGN2.9 per layer, respectively. On average, the total depreciation cost during one production cycle was about NGN181.3 per layer. However, as indicated by the standard deviation of the mean, there is higher variability among different farms that could be associated with the number of layers and type and quality of fixed assets.

Table 21: Estimated depreciation cost of major fixed assets in layer farms

	Depreciation cost NGN/layer			
Type of inputs	Mean	SD	Min	Max
Poultry shed/cage	176.04	252.91	2.56	720.00
Feeder	4.15	3.46	0.56	10.25
Drinker	2.90	2.12	0.37	6.22
Total depreciation	181.33	253.87	3.30	732.48

SD=standard deviation; Min=minimum; Max=maximum

6.3 Total value of production

Mainly layer farms generate incomes from selling eggs, spent hens and manure. In this assessment, we computed the average income generated from the three sources using the reported volume of outputs and prices of products. Although layer chickens have at least three egg production stages (starting stage, peak and ending stages), in this assessment, we used the reported average number of eggs produced in a month. The average value of spent hens and manure was also estimated from the reported amount of these products and their selling prices. Table 22 summarizes the sources and the average amount of income generated in one production cycle. The average amount of total income generated by sampled layer farms was about NGN12,675.1 per layer. About 88.6% of the income was generated from the sale of eggs. The average income generated from the sale of eggs was NGN11,224.0 per layer. Producers generated NGN1,415.4 and NGN77.3 per layer from the sale of spent hens and manure, respectively.

Table 22: Sources and amounts of income generated by layer farms

	Amount of income (NGN/layer)			
Source of Income	Mean	SD	Min	Max
Sale of eggs	11,224.0	4217.7	4,158.0	19,980.0
Sale of spent hen	1,415.4	215.4	1,200.0	2,000.0
Sale of manure	77.3	83.5	1.0	180.0
Total income	12,675.1	4,392.0	5,358.0	21,983.8

SD=standard deviation; Min=minimum; Max=maximum

6.4 Estimated farm profitability of layer farms

Using the above-estimated revenue and cost data, we applied cost-benefit analysis to evaluate the overall economic performance of sampled layer farms. On average, despite higher variability among farms, producers generate about NGN6,353.1 per layer net farm income in one production cycle (Table 23). The overall gross margin was 43.1%, with a minimum of 16.4% and a maximum of 69.3%. In this case, the gross margin shows that, on average, layer farms generate NGN43.1 from each NGN100 sale revenue to cover overhead and fixed assets costs. This indicates that most layer farms had good economic performance, indicating existing better business opportunities in the sector.

Table 23: Summary of benefit and cost of layer farms

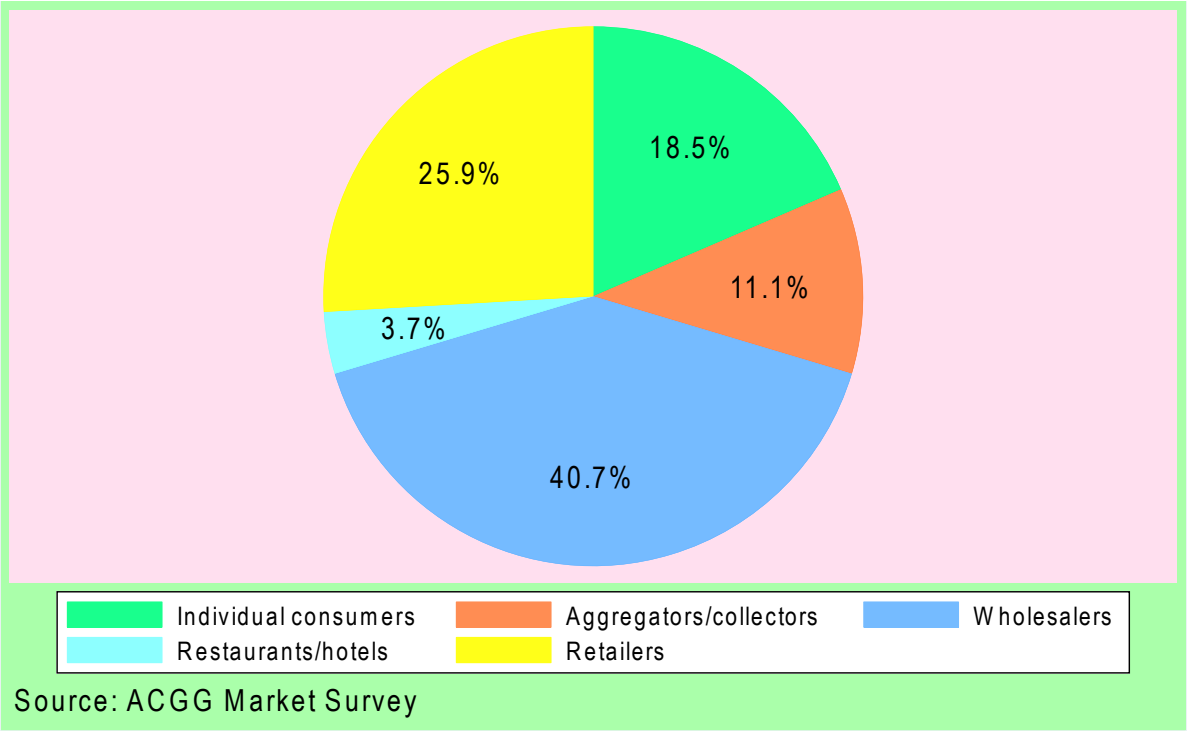
	Amount in NGN/layer			
Income/cost	Mean	SD	Min	Max
Total income	12,675.1	4,392.0	5,358.0	21,983.8
Total cost	6,322.0	2,565.2	2,292.4	11,832.4
Gross farm income	6,520.5	3,509.4	1,107.1	12,539.6
Net farm income	6,353.1	3,540.1	1,107.1	12,518.0
Gross margin (%)	43.1	17.0	16.4	69.3

SD=standard deviation; Min=minimum; Max=maximum

6.5 Major buyers of eggs and price determination

Unlike smallholder producers, commercial layer farms had better access to market and marketing information. Due to their proximity to urban markets and better networks, layer farms had different buyers such as individual consumers, aggregators, wholesalers, restaurants/hotels and retailers (Figure 19). Wholesalers and retailers are the most frequent buyers reported by more than half of the farms. Compared with smallholder producers, the proportion of individual buyers was lower. This is expected, as most layer farms sell eggs in large quantities due to the higher production volume.

Figure 19: Proportion of major egg buyers reported by layer farms.



The price formation mechanism involves both buyers and sellers. According to sampled respondents, producers (84.6%) and wholesalers/retailers (30.7%) were involved in determining the price of eggs. Producers used the cost of production and market conditions to set prices. Moreover, different criteria such as egg size (92.3%), eggshell (53.9%), egg colour (38.5%), yolk colour (23.1%) and type of breed (15.4%) are used as grading criteria to set the price of eggs.

6.6 Coordination and collective actions

Commercial farms have better access to networks and collective actions. We asked layer farms if they had any production or sale agreement with any value chain actors in their areas. Accordingly, 30.77% of the sampled layer farm reported having at least one production agreement in the previous 12 months. A higher percentage of the layer farms (76.9%) was poultry production and marketing association members. According to sampled respondents, the benefits obtained from this membership include better access to market information, linkages to new buyers, access to finance and experience sharing on production and marketing management.

6.7 Major challenges, opportunities and suggested solutions

Commercial layer farms reported different production-related constraints in their areas. High feed cost was the first most crucial production constraint reported by 61.5% of the sampled respondents. Producers have shown that if the recurring increase in feed cost continues, it will hamper the production of eggs in the country. As indicated above, feed cost accounts for the most significant proportion of the variable cost reported by producers. High feed cost could be associated with an underdeveloped feed production and marketing system that would increase the likelihood of transferring the overall cost to producers (Nzeka and Beillard, 2019). Therefore, high production costs may lead to an increase in the price of eggs, resulting in lower demand, especially during a decrease in the income of consumers. The other essential challenges raised by layers farms were lack of skilled farm workers, disease outbreaks, egg breakage and spoilage, extreme weather conditions and limited access to finance. Since layer farms need trained operators than broiler farms, the farm operators' limited capacity was considered an important challenge. Due to a longer production duration, layer farms were more vulnerable to disease outbreaks, indicating the role of establishing better biosecurity systems.

Employment opportunities, source of income, building entrepreneurship skills and other socio-economic contributions were the main opportunities reported by sampled layer farms. To exploit available opportunities and minimize the challenges noted above, respondents suggested the following interventions or policy options: enhancing the feed production sector through different strategies; developing capacity-building strategies on poultry production; developing sustainable strategies for disease prevention and control; improving access to finance and establishing institutions that support the sector in different aspects.

7. Economic performance of small-scale broiler farms

The rise of broiler farms in urban and peri-urban areas has enhanced the supply of poultry meat to the growing population in most developing countries, including Nigeria. Farmers consider broiler production as a business opportunity with low investment but quick returns. If markets are available, broiler farms can generate good returns within a short period. We interviewed sampled small-scale broilers farms in the three market sheds about their production and marketing activities and existing challenges and opportunities in the sector during this assessment. In the following section, we present a summary of the main findings of this brief assessment.

7.1 Production and productivity indicators of broiler farms

We generated data on the type of breeds they kept and the average number of production days and cycles in the previous 12 months. During this assessment, producers kept Lohmann, Marshall, Arbor Acre, Agrited and others chicken breeds. The average number of days broilers reached for slaughter was about 64 days, with a minimum of 35 and a maximum of 90 days (Table 24). Variation in the number of days kept could be associated with the type of breeds or chicken growth rate, management, and market access. Producers explained that sometimes they keep the broiler for a more extended period due to the absence of adequate markets. On average, producers had four production batches in a year with a minimum of two and a maximum of eight batches. Like smallholder producers, some broiler farms produced chicken only for major annual holidays. Compared to Abuja and Lagos, small-scale broiler farms in Port Harcourt had higher production batches and a lower production duration associated with access to better markets and input supplies.

Table 24: Days to slaughter and number of batches

	Number of batches/year				Days to slaughter			
Market shed	Mean	SD	Min	Max	Mean	SD	Min	Max
Abuja	4.0	1.9	2.0	8.0	67.0	16.2	35.0	90.0
Lagos	3.2	1.0	2.0	4.0	66.3	18.4	42.0	90.0
Port Harcourt	4.8	1.5	3.0	6.0	51.8	11.3	42.0	63.0
Total	3.9	1.7	2.0	8.0	63.8	16.5	35.0	90.0

SD=standard deviation; Min=minimum; Max=maximum

On average, broiler farms had about 257 broiler/batch at a starter stage, with a minimum of 30 and a maximum of 1,150 broilers. They had 241 broilers/batch at the finisher stage, with a minimum of 28 and a maximum of 1,039 broilers (Table 25). The average mortality was 7.4%, which could be resulted from disease and management issues. Compared to Abuja and Port Harcourt, the reported loss in Lagos was low, which is 3.9%. The lower level of mortality could be associated

with better management practices and improved access to vaccines, drugs and health services. Furthermore, the higher standard deviation in the mean number of chicks at the starter and finisher stage shows higher variability in the number of chicks kept by producers during a given production cycle. For instance, the average number of chicks reported in the Abuja market shed was lower than the other two.

Table 25: Average number of broilers produced in one production cycle

	Abuja		Lagos		Port Harcourt		Overall	
No. of chicks	Mean	SD	Mean	SD	Mean	SD	Mean	SD
No. starter	138.0	136.6	400.3	409.6	337.5	179.7	256.6	270.9
No. finisher	128.3	134.9	379.3	385.8	312.5	186.7	240.5	259.0
Proportion of sold (%)	91.0	6.2	96.1	2.6	91.1	6.5	92.6	5.7

7.2 Cost of production

7.2.1 Type and value of variable inputs

Table 26 presents a summary of variable inputs used by sampled broiler farms. From the total variable costs, the feed cost accounted for 57.5%, followed by the price of day-old chicks, which was 25.9%. The price of day-old chicks was lower in Lagos than in Abuja and Port Harcourt. This is expected as there were a larger number of hatcheries in Lagos than Abuja and Port Harcourt. Similarly, the cost of vaccination and antibiotics was higher in Abuja than in the other two market sheds. To sum up, compared to Lagos and Port Harcourt, the cost of production in Abuja was higher due to the higher cost of feed, vaccination and antibiotics. This reflects existing spatial variability in input prices because of access to input suppliers and distance to main marketing centres.

Table 26: Types and values of variable costs in broiler farms (NGN/broiler)

	Abuja		Lagos		Port Harcourt		Overall		Share (%)
Type of cost	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean
DOCs	292.0	44.2	251.7	37.6	287.5	29.9	279.0	42.2	25.9
Feed	656.8	258.2	597.8	299.6	561.1	198.2	619.9	251.0	57.5
Litter	18.7	13.3	1.2	1.2	22.8	17.4	16.9	14.3	1.6
Brooding cost	23.1	12.3	24.0	10.2	45.3	28.4	29.2	19.1	2.7
Electricity	53.7	41.3	19.3	13.8	5.7	2.2	31.0	34.5	2.9
Vaccination	33.5	26.1	19.6	10.4	15.2	5.6	24.8	19.6	2.3
Antibiotics	53.1	42.0	30.7	23.9	27.3	23.3	41.3	34.8	3.8
Transportation	29.9	19.1	14.4	11.1	16.1	11.6	22.1	16.5	2.1
Water	22.5	14.4	8.4	5.7	5.5	0.8	16.3	13.6	1.5
Hired wage	22.2	55.7	30.9	39.6	66.5	7.0	33.7	46.8	3.1
Other miscellaneous	0.5	1.6	2.5	6.0	1.7	3.3	1.3	3.6	0.1
Total	1,154.6	258.1	976.3	336.7	1,039.4	204.4	1,078.1	273.2	100.0

7.2.2 Average annual depreciation cost for fixed assets

Average annual depreciation costs for fixed assets were estimated using the reported values of the cost of construction/purchase and longevity of the assets. Based on the reported cost of construction/purchase, the average depreciation costs for house/shed was about NGN24.1 per broiler (Table 27). Similarly, the average annual depreciation cost for feeder and drinker were about NGN2.3 and NGN1.4 per broiler, respectively. The overall average yearly cost of fixed assets was about NGN27.8 per broiler, with a minimum of 4.1 and a maximum of NGN141.1 per broiler. However, it is

also possible to see high variability in the value of housing cost among different farms from this table. These would be associated with the size and quality of houses, construction, year of construction and other inputs used.

Table 27: Estimated annual depreciation cost of fixed assets in broiler production

	Annual depreciation cost			
Type of fixed asset	Mean	SD	Min	Max
House/shed	24.1	32.5	2.8	140.0
Feeder	2.3	2.9	0.1	12.3
Drinker	1.4	1.8	0.1	7.1
Total cost	27.8	31.9	4.1	141.1

SD=standard deviation; Min=minimum; Max=maximum

7.3 Estimated farm profitability of broiler production

The profitability of broiler farms was estimated using the reported inputs and output values. Broiler farms generate income mainly from the sale of chicken and manure. The total revenue was computed using the reported numbers of chicks at the finisher stage and average selling prices. On average, producers generated a gross income of NGN1,794.1 per broiler, with a minimum of NGN1,333.8 per broiler in Port Harcourt and a maximum of NGN2,223.4 per broiler Lagos (Table 28). As indicated above, the higher average income generated in Lagos could be associated with the reported lower variable costs, better selling prices and higher survival rate of chicken or lower mortality rate.

Table 28: Gross farm income of broiler production by market shed

	Income/broiler		Variable cost/broiler		Gross farm income (NGN/broiler)	
Country	Mean	SD	Mean	SD	Mean	SD
Abuja	2,875.3	1,019	1,154.6	258.1	1,720.7	1,065.6
Lagos	3,199.7	633.3	976.3	336.7	2,223.4	575.8
Port Harcourt	2,373.2	1,246.6	1,039.4	204.4	1,333.8	1,250.5
Overall	2,872.2	963.9	1,078.1	273.2	1,794.1	988.8

The estimated gross margin for each market shed is presented in Figure 20. On average, broiler farms generated about 55.1% gross margin. This shows that broiler producers generate NGN55.1 as a gross income for each NGN100 sale income to cover overhead and other fixed costs. Like other efficiency indicators, the average gross margin in Lagos was higher than the average amount in the other two market sheds.

Figure 20: Estimated gross margin of broiler production by the market sheds.

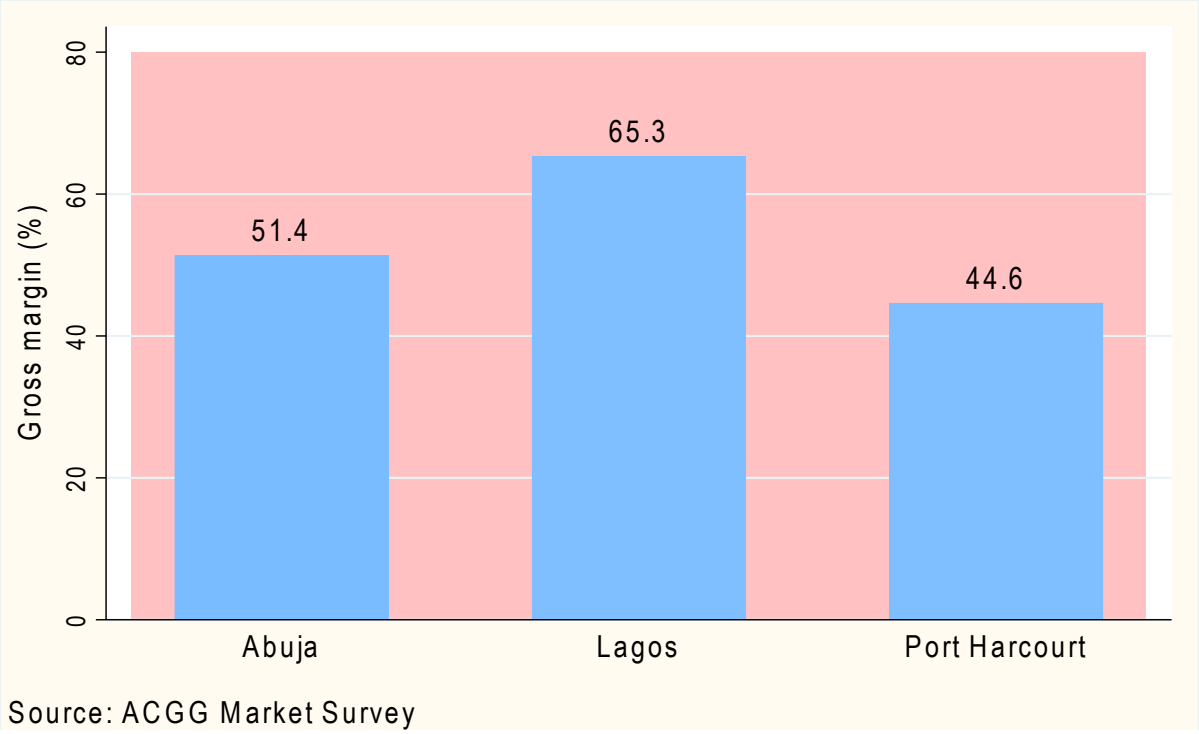


Table 29 presents the overall annual gross and net farm income. The average annual net farm income generated from broiler production was about NGN1,407,700 with a minimum of NGN125,400 and a maximum of NGN9,579,200. The estimated standard deviation for the net farm income indicates high variability in sampled broiler farms' performance. This could be associated with the size of farms, cost of production, selling prices and other management-related issues. Farms with more batches and a larger production volume would generate higher annual net farm income than others.

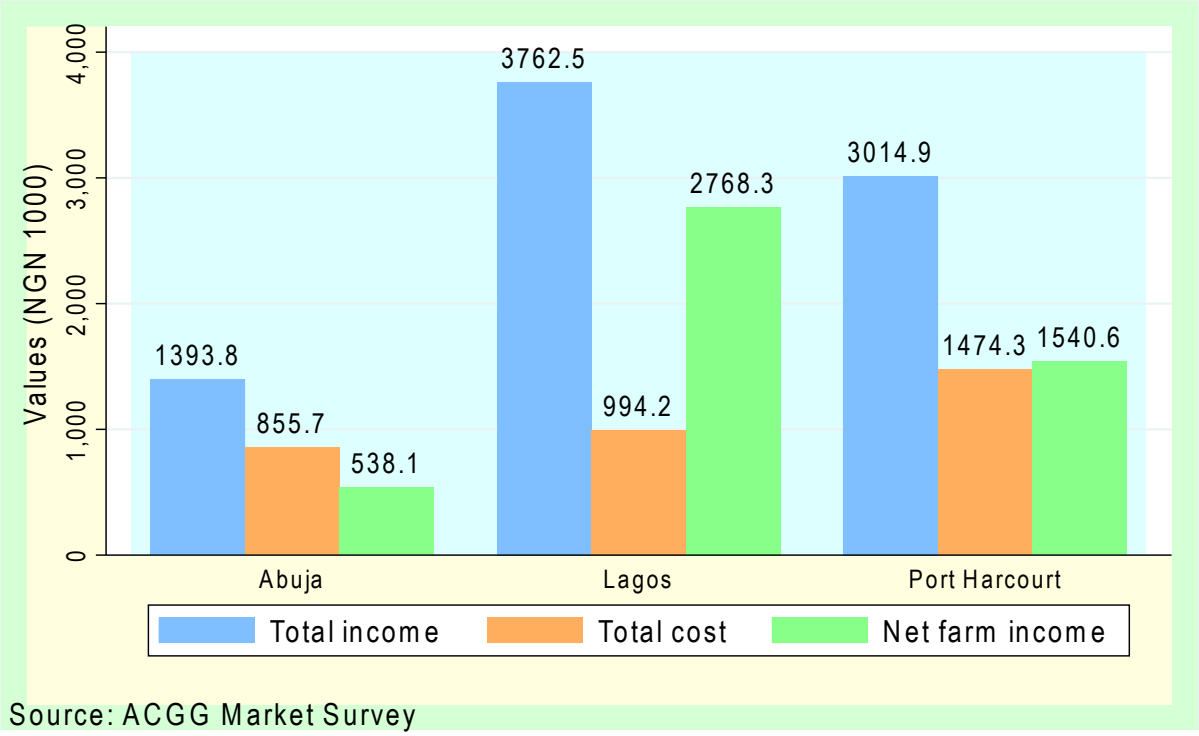
Table 29: Gross and net farm income of broiler production

	Average income and cost (NGN1,000)			
Indicators	Mean	SD	Min	Max
Total income	2428.6	2724.4	223.5	11601.8
Total variable cost	1002.9	1195.6	96.5	5323.7
Total cost (variable + fixed)	1021.0	1200.7	98.1	5344.7
Gross farm income	1425.8	2133.3	127.0	9658.1
Net farm income	1407.7	2120.9	125.4	9579.2

SD=standard deviation; Min=minimum; Max=maximum

There was also a significant difference between the value of net farm income generated by broiler farms in the three market sheds. Figure 21 presents a summary of annual net farm income disaggregated by market shed. The average net farm income in the Lagos market shed was significantly higher than Abuja and Port Harcourt market sheds. Conversely, the overall net farm income generated in the Abuja market shed was lower than the two market sheds. The lower net farm income could be associated with the high cost of inputs, lower selling prices, and lower chicken production per year because of limited access to better markets. Unlike the gross margin, Abuja's annual net farm income was lower than Port Harcourt, attributable to the lower batch or volume of production in this market shed.

Figure 21: Summary of costs and benefits in broiler production.

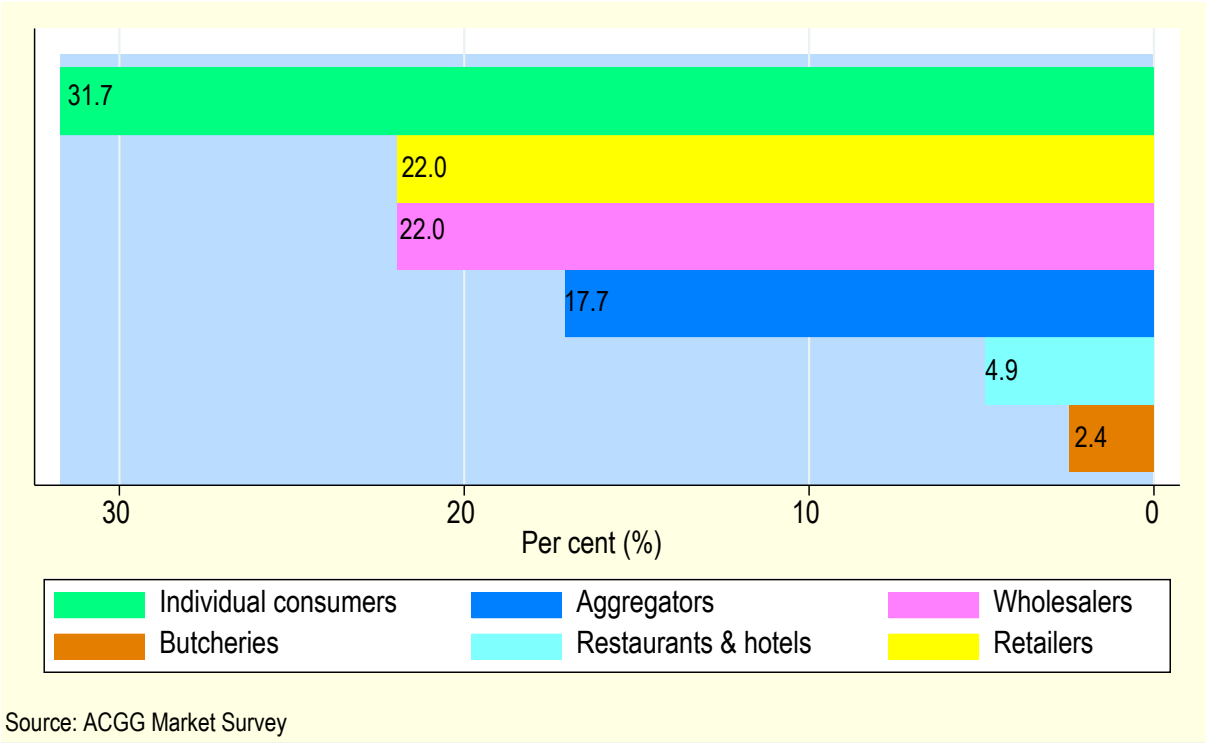


Source: ACGG Market Survey

7.4 Major buyers of broilers and price determination

Broiler farms explained that they had diverse marketing channels for their products. The main channels include individual consumers, aggregators, traders (wholesalers and retailers), processors, restaurants and hotels. In the previous 12 months, from the total reported buyers, individual consumers accounted for the highest proportion (31.7%), followed by retailers (22.0%) and wholesalers (22.0%) (Figure 22). The remaining 24.4% accounted for aggregators, restaurants and hotels, and processors. About 65.0% of the sampled respondents reported that they sold to individual consumers. Since our sampled broilers farms were small-scale producers, most targeted individual consumers as main buyers for their products. Some of the sampled respondents sometimes receive orders from individual consumers and produce the broilers based on predefined agreements. Wholesalers, retailers and aggregators also resell broilers in the local markets. A higher proportion of sales at the local market may show that current small-scale broiler production targets local consumers highly dependent on seasonal consumption patterns in the country.

Figure 22: Proportion of major reported broiler buyers.



Source: ACGG Market Survey

Most of the sampled respondents (95.0%) said producers determine the price of live chickens. Only 10% of the respondents noted the role of traders in price determination. The highest proportion of producers (88.3%) explained that they used grading criteria during price determination. Attributes such as body weight or body size (95.0%), health status (30.0%) and type of breeds (30%) were used in price determination. Broilers with higher body weight and good health conditions fetched better prices than those with lower body weight and poor health. Some of the broiler breeds were preferable to others. A producer also indicated the role of cleanliness in price determination. Clean birds attract buyers, and unclean birds do not. Unlike smallholder producers, plumage colour does not have a vital role in price determination.

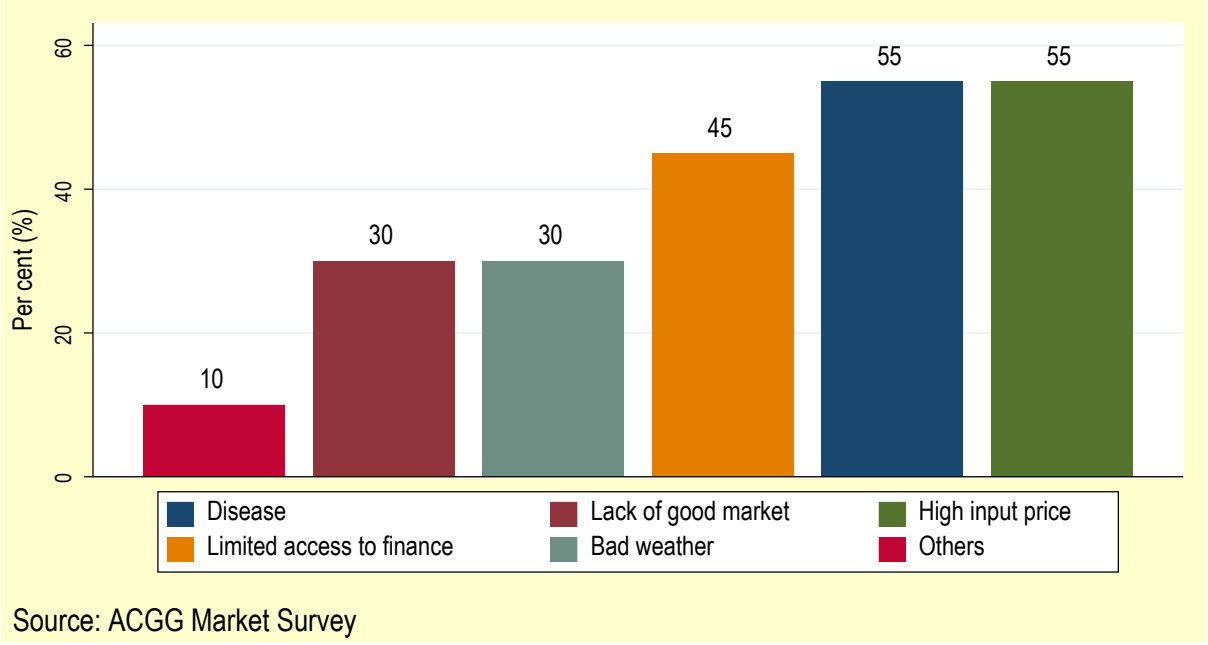
7.5 Coordination and collective actions

We asked broiler farms about their experience in coordination and collective action in the previous 12 months. This may include a production or sale agreement and membership in poultry-related associations. Only 10% and 30% of the sampled respondents reported participation in production agreements and membership in poultry-related associations, respectively. Sampled broiler farms had limited horizontal and vertical coordination. Producers' limited coordination may lead to an increase in marketing costs and a higher level of inefficiency, affecting the value chain's competitiveness. According to sampled respondents, better access to market information, market linkages, access to market and training were the benefits of this membership. The proportions of broiler producers who participated in coordination and collective action were lower than the proportion of producers in layer production.

7.6 Challenges and opportunities in broiler production

We asked broiler farmers to list the three main constraints in broiler production and marketing activities. Accordingly, 55% of the sampled respondents mentioned disease and high input price as their main constraints (Figure 23). Like mother unit farms, some of the broiler producers believe that some diseases are hatchery borne. Empirical researches have also documented the possibility of disease transmission through eggs along the value chain (Chen and Wang, 2002, Agabou, 2009, Kim and Kim, 2010). Due to poor infrastructure and inadequate biosecurity measures, hatcheries could be a potential source of diseases. Sampled broiler farmers have also reported an increasing feed price as a major constraint. Next to disease and high input price, limited access to finance such as credit was reported as a major constraint. Others also noted harsh weather conditions like extremely hot and cold temperatures and sustainable markets as the main constraints. As indicated above, in addition to the difference in growth rates, higher variability in the days to slaughter could be associated with limited access to a ready market.

Figure 23: Major production and marketing constraints raised by broiler farms.



Source: ACGG Market Survey

Based on their experience, we asked farmers to explain different opportunities they experienced in running broiler farms. Of the total respondents, 85% indicated broiler farming was a good source of income. According to sampled farms, broiler farming creates a better employment opportunity that helps to generate income quickly. Unlike layer farms, broiler farming could be run with small capital and generate modest returns within a few weeks. Moreover, some of the sampled respondents reported its contribution to household food and nutritional security. Others mentioned higher demand for products and manure availability for other agricultural activities as essential opportunities in this business. Producers' positive experience in small-scale broiler production suggests enhancing the sector through better research and development interventions to address production, marketing and consumption challenges.

8. Marketing actors: aggregators, wholesalers and retailers

Like the production and consumption aspect, access to the market has a significant role in improving the productivity of the agricultural sector. Better marketing opportunities enhance the sector's production and productivity and adopt better production practices and improved technologies. Different marketing actors participate in moving poultry products from the farm gate to final consumers along the value chain. These include aggregators, wholesalers and retailers that operate with specific or multiple roles. For instance, aggregators may assemble products to sell to retailers or wholesalers, but sometimes they also directly sell to individual consumers. Correspondingly, in most places, wholesalers also undertake retail-selling activities. During this brief assessment, we interviewed selected marketing actors on different marketing aspects to highlight the performance of egg and live chicken marketing activities in the sampled market sheds. The following sections present summaries of the main findings.

8.1 Live chicken aggregators/collectors

Aggregators or collectors buy live chickens and eggs from smallholder producers at the farm gate and sell them to retailers or wholesalers in the central markets. Usually, they move from village to village and collect eggs or chickens directly from smallholder producers. They play a significant role in the smallholder chicken production systems, as they help move products from the rural areas to the central markets. We interviewed few live chicken aggregators about their suppliers, principal buyers, purchase and selling prices, and challenges and opportunities in live chicken aggregation.

8.1.1 Source of supply, main buyers and price margin

Sampled aggregators work in this business as a full-time job. Their leading suppliers were smallholder producers and small-scale commercial producers. Aggregators explained that the supply of chickens is highly dependent on seasons. They considered December and April as peak live chicken supply seasons and July and August as low supply seasons. They sold live chickens to individual consumers, restaurants and hotels in the central markets. But few of them sold to retailers, processors and wholesalers. The average reported buying and selling prices were about NGN1,620.8 and NGN2,013.3 per chicken, respectively (Table 30). The estimated average marketing cost was about NGN94.0 per chicken. The marketing costs include the cost of feed, transport, water and disease treatment. On average, aggregators generated about NGN420.6 per chicken profit, with a minimum of NGN124.7 and a maximum of 991.3 per chicken. Since some of the sampled aggregators could directly sell to consumers and hotels/restaurants, they could generate a higher profit margin per chicken than others.

Table 30: Estimated profit margin of aggregators

	Values in NGN/chicken			
Price/cost	Mean	SD	Min	Max
Buying price	1,620.8	310.8	1,425.0	2,250.0
Marketing cost	94.0	22.0	75.4	127.1
Selling price	2,013.3	378.1	1,700.0	2,616.7
Profit margin	420.6	352.9	124.7	991.3

SD=standard deviation; Min=minimum; Max=maximum

8.1.2 Challenges and opportunities reported by aggregators

Like other value chain actors, we asked aggregators to explain the most significant challenges they faced during live chickens collecting and selling. Accordingly, disease/morality (62.5%), absence of temporary shelter (50.0%), high feed cost (37.5%), price fluctuation (37.5%) and limited access to credits (25.0%) were the core constraints raised by aggregators. After buying, high disease incidence or death of chickens could result from inadequate disease treatment and prevention at producers' level, poor transportation facilities and poor management between buying and selling. To solve their challenges, aggregators suggested targeted interventions that improve the producer level's health services provision and enhance access to drugs and treatment services along the value chain. Furthermore, improving access to finance and developing better transportation facilities were also indicated as the other necessary intervention. Aggregators feel that this business has created employment opportunities that generate modest income to support their households despite the above constraints and challenges.

8.2 Live chicken wholesalers and retailers

8.2.1. Source of live chicken supply

The other important actors in live chicken marketing are wholesalers and retailers. Wholesalers purchase live chickens from different suppliers and sell in bulk to consumers or other traders like retailers. On the other hand, retailers buy live chicken from producers or other traders like wholesalers or aggregators and sell directly to consumers. Despite their interlinked or overlapping roles, each actor has an essential function along the value chain. During our assessment, we interviewed selected wholesalers and retailers about their supply source, the share of the supply from each source, purchase and selling prices, principal buyers, price determination mechanism, collective action and membership in different associations and possible challenges and opportunities. Table 31 presents a summary of the source of live chicken supply for both retailers and wholesalers. For retailers, the major suppliers were smallholder producers, small-scale commercial producers, large-scale commercial producers and wholesalers. Many of the retailers got their supply from smallholder producers and small-scale commercial producers. Retailers usually buy spent hens from commercial producers and cocks from smallholder producers. Small-scale and large-scale commercial producers were the leading suppliers of live chicken to wholesalers. However, unlike retailers, the most significant supply came from large-scale commercial producers followed by small-scale commercial producers. Wholesalers did not report supply from smallholder producers.

Table 31: Major reported sources of live chicken supply

Type of suppliers	Retailers		Wholesalers		Total	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Smallholder producers	60.0	60.0	0.0	100	26.7	73.3
Small-scale commercial producers	60.0	40.0	60.0	40.0	60.0	40.0
Aggregators	0.0	100.0	0.0	100.0	0.0	100.0
Large-scale commercial Producers	30.0	70.0	80.0	20.0	46.7	53.3
Retailers	0.0	100.0	0.0	100.0	0.0	100.0
Wholesalers	10.0	90.0	0.0	100.0	6.7	93.3

8.2.2 Quantity bought and buying price

The buying price and quantity of chickens bought mainly depend on the type of chickens and suppliers. Both retailers and wholesalers got the largest proportion of supply from commercial producers. According to sampled respondents, while retailers bought on average 292 live chickens per month, wholesalers bought about 2,294 live chickens/month (Table 32). This difference is expected as wholesalers usually handle a higher number of chickens than retailers.

Table 32: Average quantity of live chicken bought by traders (number/month)

	Retailer				Wholesaler			
Source of supply	Mean	SD	Min	Max	Mean	SD	Min	Max
Smallholder producers	130.4	104.9	56.7	280.0	-	-	-	-
Small-scale commercial	199.4	181.7	30.0	423.3	1,644.4	2077.2	75.0	4,000.0
Large-scale commercial	166.7	158.8	73.3	350.0	1,634.2	1682.4	95.0	3,500.0
Wholesalers	700.0	-	700.0	700.0	-	-	-	-
Overall	291.8	201.1	73.3	700.0	2294.0	1877.2	170.0	4,000.0

SD=standard deviation; Min=minimum; Max=maximum

The average buying price for retailers was NGN1,529.2 per chicken, with a minimum of NGN1,438.9 per chicken from large-scale commercial producers and NGN1,600.0 per chicken from smallholder producers (Table 33). For wholesalers, the average buying price was NGN1,315.3 per chicken, with a minimum of NGN1,316.7 per chicken from large-scale commercial producers and a maximum of NGN1,370.0 per chicken from small-scale commercial producers. Lower buying prices from commercial producers than smallholder producers could be associated with the type of chickens and purchase volume. For instance, commercial producers usually supply improved spent hens that usually fetch a lower price than local cocks. There was a difference in the buying prices of live chickens between retailers and wholesalers, and supply sources. The average buying price of retailers from small- and large-scale commercial producers was higher than wholesalers buying price. The lower buying price for wholesalers is expected due to a higher purchase and type of chicken, leading to a lower price offer. Moreover, higher buying prices from smallholder producers could be associated with breeds types.

Table 33: Average buying price of live chickens (NGN/chicken)

	Retailer		Wholesalers		Overall	
Source of supply	Mean	SD	Mean	SD	Mean	SD
Smallholder producers	1,600.0	87.1	-	-	1,600.0	87.1
Small-scale commercial	1,522.2	117.2	1,370.0	158.8	1,471.5	143.8
Large-scale commercial	1,438.9	58.5	1,316.7	155.8	1,369.1	132.4
Wholesalers	1,550.0	-	-	0	1,550.0	-
Overall	1,529.2	110.1	1,315.3	134.9	1,457.9	154.5

8.2.3 Type of buyers, quantity sold and average selling price

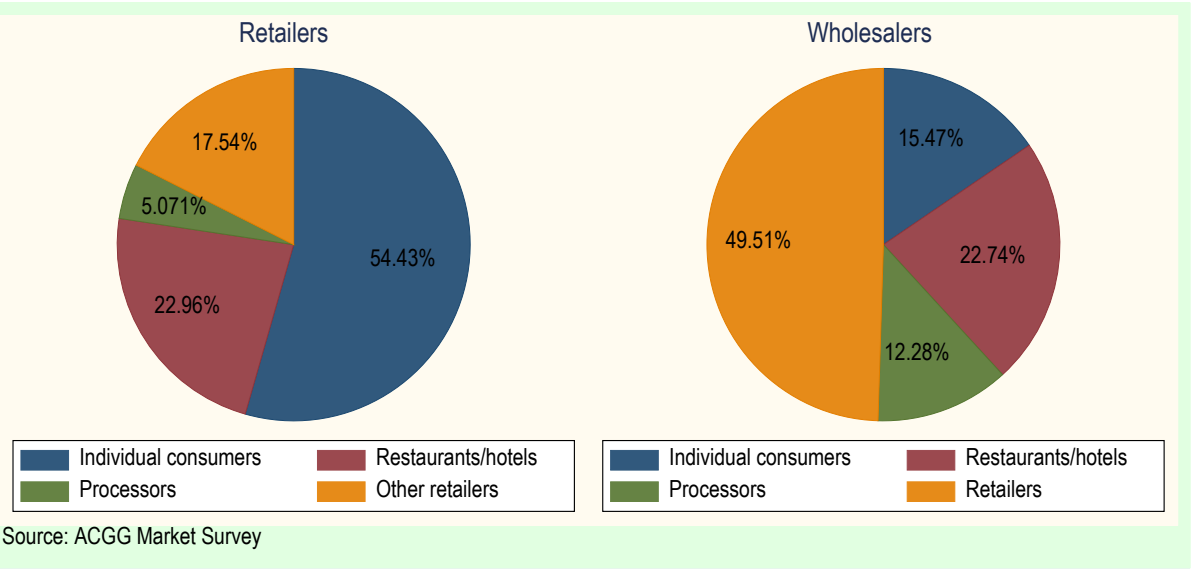
Wholesalers and retailers' primary buyers include individual consumers, restaurants and hotels, processors, other retailers and other wholesalers. All the retailers and most wholesalers reported individual consumers as their major buyers (Table 34). Next to individual consumers, restaurants and hotels were the main buyers for retailers. A sizeable proportion of wholesalers also sold to retailers, restaurants and hotels. Compared to retailers, wholesalers had a wider range of buyers as they may undertake retailing activity also. However, it is possible to say that both retailers and wholesalers had similar types of buyers. For instance, during the previous 12 months, from total respondents of wholesalers and retailers, 93.8% of them sold to individual consumers, while 66.7% of them sold to restaurants and hotels (Table 34). The overall average selling price of both retailers and wholesalers was about NGN1,793.0 per chicken, with a minimum of NGN1,703.0 and a maximum of NGN1,828.0 per chicken. Higher variability in selling price could be associated with type chickens and their body size or weight. The average selling price between traders was lower than that of other buyers, which is expected.

Table 34: Major types of live chicken buyers reported by wholesalers and retailers

Type of buyers	Type of buyers (%)						Average selling price (NGN/chicken)	
	Retailers		Wholesaler		Overall			
	Yes	No	Yes	No	Yes	No	Mean	SD
Individual consumers	100.0	0.0	80.0	20.0	93.8	6.3	1,828.0	188.7
Restaurants/hotels	60.0	40.0	80.0	20.0	66.7	33.3	1,809.9	177.4
Processors	40.0	60.0	40.0	60.0	40.0	60.0	1,783.3	191.7
Other retailers	40.0	60.0	80.0	20.0	53.3	46.7	1,703.0	251.0
Other wholesalers	0.0	100	20.0	80.0	6.7	93.3	-	-
Overall	-	-	-	-	-	-	1,793.0	166.4

There was a significant difference in the volume of chicken sold to each of the above buyers. Figure 24 presents the proportion of live chickens sold to different buyers. Retailers sold 54.4% of live chickens to individual consumers and 23.0% to restaurants/hotels. The remaining 22.6% sold to processors and other retailers. Unlike retailers, wholesalers sold the highest proportion (49.5%) to retailers, followed by hotels and restaurants (22.7%) and individual consumers (15.5%). Processors purchased a higher percentage of chickens from wholesalers than retailers.

Figure 24: Proportion of live chicken sold to different buyers.



Source: ACGG Market Survey

8.2.4 Live chicken price determination

Evidence on the price formation at traders' level helps to evaluate the effect of existing policies and strategies in product marketing and the role of traders on the performance of the market. We asked traders who determine the price of live birds in the market. Accordingly, producers (66.7%), traders (40.0%) and consumers (13.3%) were reported as the major actors who determine the price of the live bird. The highest proportion (93.3%) of traders said they used some criteria to determine the price of live birds. These criteria include live weight (73.3%), type of breed (33.3%), plumage colour (20.0%) and age of birds (20.0%). Furthermore, 53.3% of the respondents explained the vital role of market conditions in price determination, which is mainly associated with the demand and supply of live chicken. The reported average time lag between buying and selling products was about six days, with a minimum of three and a maximum of twelve days.

8.2.5 Type and amount of major marketing costs

An efficient marketing system helps to deliver products with lower marketing costs. Higher marketing costs always indicate the inefficiency of the marketing system. To assess the efficiency of the marketing system, we asked traders (wholesalers and retailers) to identify essential marketing costs they incurred during buying, transporting and keeping the chickens until they were sold. The main marketing costs include feed, disease treatment, transportation, shop rent and water. On average, they spent about NGN 84.3 per chicken per month for the above marketing costs (Table 35). The feed cost was the major cost item, accounting for 49.2% of the total marketing costs, followed by transportation (30.2%) and shop rent (9.3%). Cost of feed and transportation were incurred by more than 90% of the traders.

Table 35: Types and values of live chicken marketing costs

	Average marketing cost/chicken/month				Proportion	
Type of cost	Mean	SD	Min	Max	traders (%)	Share (%)
Feed cost	41.5	30.8	4.0	85.4	100.0	49.2
Disease treatment	6.1	6.2	0.0	18.8	80.0	7.2
Transportation	25.4	26.1	0.0	81.8	93.3	30.2
Shop rent	7.8	7.4	0.0	23.6	73.3	9.3
Water	3.5	7.2	0.0	23.1	53.3	4.2
Total	84.3	50.1	15.1	163.9	100.0	100.0

SD=standard deviation; Min=minimum; Max=maximum

8.2.6 Marketing margins of live chicken traders

Summaries of price spread and margins of traders in the sampled market shed are presented in Table 36. In this table, the producer price stands for the average price of live chickens from the smallholder and commercial producers, and the retail prices refer to the final price paid by consumers. There was variability in the producers' prices and retail prices among the three market sheds. The average producer price in the Port Harcourt market shed was higher than the prices in Abuja and Lagos. Similarly, the average retail price in Port Harcourt was significantly higher than the prices in both markets, which could be associated with the type of birds, marketing costs and supply and demand conditions. As a result, the price spread, total gross margin and total mark-ups were higher in Port Harcourt than in the other two markets. On the other hand, producers share in the Port Harcourt market was slightly lower than the other two market sheds and traders in this market shed had a higher profit margin than others.

Table 36: Live chicken price spread, producers share and total mark-ups

	Abuja		Lagos		Port Harcourt		Overall	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Producers price	1,330.0	28.3	1,431.3	126.6	1,485.4	178.7	1,447.7	155.8
Retail price	1,654.2	170.9	1,783.3	132.6	1,872.2	188.7	1,819.4	179.6
Producer-retail price spread	324.2	199.2	352.1	77.7	410.2	287.3	381.4	244.0
Producers share (%)	80.9	10.1	80.3	4.2	79.2	13.1	79.7	10.2
Total gross margin (%)	19.1	10.1	19.8	4.2	20.8	13.1	20.7	10.2
Total mark-ups (%)	24.5	15.5	24.9	6.5	29.8	24.6	27.6	19.0

We estimated the profit margins for retailers and wholesalers using the reported buying and selling prices and marketing costs. On average, retailers and wholesalers generate NGN 175.8 and 400.8 per chicken as a profit margin, respectively (Table 37). This shows the presence of significant variability in the gross margin generated by retailers and wholesalers. A higher profit margin by wholesalers than retailers could be associated with lower average marketing costs and lower purchase prices.

Table 37: Profit margin of live chicken traders (NGN/chicken)

	Retailers		Wholesalers		Overall	
Indicators	Mean	SD	Mean	SD	Mean	SD
Buying price	1,529.1	110.1	1315.3	134.9	1,457.9	154.5
Marketing cost	92.7	53.4	67.6	43.1	84.3	50.1
Selling price	1,797.6	176.7	1,783.7	162.8	1,793.0	166.4
Profit margin	175.8	127.8	400.8	206.9	250.8	186.5

8.2.7 Coordination and collective action of traders

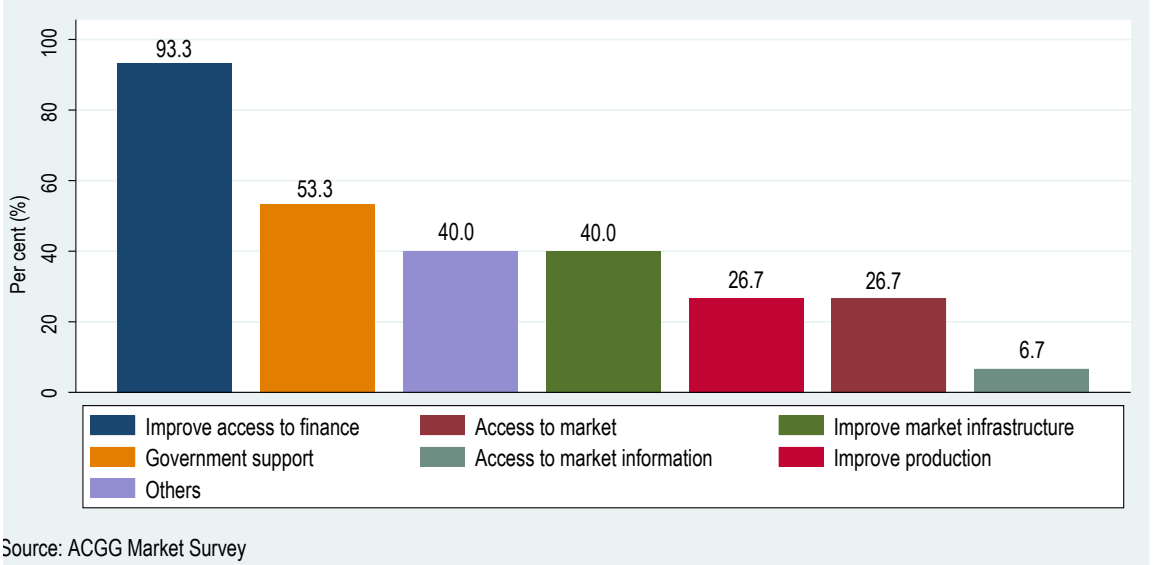
Compared to producers, live bird traders had better coordination and collective actions. Most of the live bird traders (71.43%) were members of traders or other poultry production and marketing associations. The benefits obtained from membership include access to market information (45.5%), linkage to new buyers (36.4%), access to training (27.3%), access to credit (27.3%) and access to market facilities (9.1%). This shows that traders are more coordinated than smallholder producers, giving them better bargaining power during buying and selling products.

8.2.8 Challenges and opportunities in live chicken trading

Like the production aspect, the marketing of live chicken also involves different challenges and opportunities. We asked traders to explain the main challenges they faced during the marketing of live chicken. Among others, disease or death of chickens (66.7%), higher transport cost and limited transport facilities (40.0%), high feed cost (33.3%), limited government support (26.6%), limited access to market (26.6%) and limited access to finance (20.0%) were the major challenge raised by traders. Like aggregators, most wholesalers and retailers reported a loss of chickens after buying as the most critical constraint. This could be associated with buying of sick birds and inadequate transportation and management. Most of them explained that higher feed and transport costs significantly reduced their profit margin. The existing diverse challenges suggest the inefficiency of the marketing system that affects the overall performance of the value chain. Despite the above challenges, traders explained different opportunities in this business. The most important opportunities perceived by traders include income generation, job creation and supporting producers to deliver their products to central markets. Traders elucidated that although it was not very high, the profit generated from their business has helped to support their families. They also believe that live chicken trading creates employment opportunities for young and retired men and women in their community.

As solutions to the above constraints and a strategy to exploit existing opportunities, traders suggested improving access to finance and better government support as the first and second most important interventions (Figure 25). Most traders believed enhancing access to finance would help them increase the scale and volume of their trading activities. According to some traders, the government should provide strategic support such as improving market infrastructure, building producers and traders' capacity and introducing better veterinary services along the value chain. Enhancing access to markets may include building better marketing facilities and road networks. Traders also mentioned the important role of farm-level interventions that improve production and productivity on marketing efficiency.

Figure 25: Major solutions to constraints suggested by live chicken traders.



Source: ACGG Market Survey

8.3 Eggs wholesalers and retailers

8.3.1 Source of egg supply

Like live chicken traders, egg wholesalers and retailers have significant contributions in the marketing of eggs produced along the chicken value chain. Wholesalers and retailers buy eggs from different sources and sell them to consumers or other value chain actors. The primary sources of egg supply for retailers were smallholder producers, small and large-scale commercial producers, and wholesalers. Most retailers bought eggs from small-scale commercial producers, followed by large-scale commercial producers' and wholesalers (Table 38). Unlike retailers, the primary sources of egg supply for wholesalers were large-scale and small-scale commercial producers. None of the wholesalers reported egg purchases from smallholder producers in the previous 12 months. This may be associated with their higher volume of purchases.

Table 38: Major sources of egg supply for traders

	Retailers		Wholesalers		Total	
Type of suppliers	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Smallholder producers	22.2	77.8	0.0	100	11.1	88.9
Small-scale commercial producers	66.7	33.3	37.5	62.5	52.9	47.1
Large-scale commercial producers	55.6	44.4	62.5	37.5	58.8	41.2
Wholesalers	33.3	66.7	0.0	100	17.6	82.4

8.3.2 Quantity of eggs bought and buying price

The average amount of eggs bought from different sources depends on the production capacity of each producer. Table 39 summarizes the average quantities of eggs bought from different sources and the average buying prices. Retailers bought the lowest amount from smallholder producers and the highest amount from small-scale commercial producers. The average volume of eggs bought by wholesalers was by far greater than retailers. On average, both wholesalers and retailers purchased a crate of eggs with NGN 867.6. The average buying price from smallholder producers was higher than the buying price from commercial producers. This could be associated with the difference in the type of breeds kept by these producers. As indicated above, some eggs bought from smallholder producers are local breed eggs that can fetch higher market prices than eggs from improved breeds.

Table 39: Quantity of egg bought and average buying price

	Average quantity bought (Crate/month)						Average buying price	
	Retailers		Wholesalers		Overall		Overall	
Type of suppliers	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Smallholder producers	23.8	7.8	-	-	23.8	7.8	985.0	162.6
Small-scale commercial producers	328.0	183.2	1077.8	1154.9	609.2	742.2	837.1	41.4
Large-scale commercial producers	151.3	116.9	1141.7	1104.4	646.5	905.9	831.9	51.1
Wholesalers	168.0	169.7	-	-	168.0	169.7	927.8	149.4
Overall	327.6	333.7	1117.7	1038.8	699.4	832.5	867.6	97.8

8.3 3 Type of egg buyers and average selling price

Wholesalers sold eggs to individual consumers, restaurants and hotels, institutional buyers, retailers and other wholesalers. Correspondingly, retailers sold to individual consumers, restaurants/hotels and other retailers. Although

all wholesalers and retailers sold to individual consumers, there were significant variations among other buyers. Due to their higher demand, the percentage of restaurants/ hotels and institutional buyers who bought eggs from wholesalers was higher than those who bought from retailers. Like the buying prices, there was also a difference in the selling prices for various buyers. The overall average selling price was NGN957.4 per crate (Table 40). The average selling price for individual consumers was higher than the selling price for restaurants and institutional buyers. This difference is expected due to the existing price discount practice for buyers who purchase in large quantities than others.

Table 40: Types of buyers and average selling price

	Type of buyers						Selling price (NGN)	
	Retailers		Wholesalers		Overall		Overall	
Type of buyers	Yes	No	Yes	No	Yes	No	Mean	SD
Individual consumers	100.0	0.0	100.0	0.0	100.0	0.0	962.4	115.2
Restaurants/hotels	33.3	66.7	55.0	50.0	41.2	58.8	931.2	69.6
Institutional buyers	0.0	100	12.5	87.5	5.9	94.2	1,028.7	30.2
Other retailers	33.3	66.7	87.5	12.5	58.8	41.2	917.7	71.6
Other wholesalers	0.0	100.0	12.5	87.5	5.9	94.1	-	-
Overall							957.4	118.4

8.3.4 Egg price determination

The findings of our assessment show the role of different actors in the egg price formation mechanism. Traders explained that the price of eggs was determined by producers (66.7%), traders (38.9%), consumers (16.7%) and market conditions (11.1%). A higher percentage (75%) of traders indicated they used grading or quality standards during price determination. Accordingly, egg size (66.6%) was an essential criterion to determine the price of eggs. Only very few traders reported using a type of breed, eggshell colour and yolk colour as price determination criteria. The average time lag between buying and selling products was about six days, with a minimum of one and a maximum of twenty-one days.

8.3.5 Marketing margins of egg traders

We estimated the producer price spread, producers share and traders' gross margin using the reported prices. The average pproducers' price and producer-retail price spread were higher in the Port Harcourt market shed than others, which may be associated with production costs and higher demands (Table 41). In the Abuja market shed, the retail price's producer share was higher, which would result in lower traders' gross margin and total mark-ups.

Table 41: Egg price spread, producers share and total mark-ups by market sheds

	Abuja		Lagos		Port Harcourt		Overall	
Indicators	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Producers price	820.00	4.71	849.38	105.31	897.14	103.76	865.59	98.58
Retail price	887.17	5.42	947.50	135.53	1,014.86	150.61	968.14	136.13
Producer-retail Price spread	67.17	0.71	98.12	47.74	117.71	52.92	102.55	48.11
Producers share (%)	92.43	0.03	89.87	4.06	88.72	3.12	89.70	3.50
Traders gross Margin (%)	7.57	0.03	10.13	4.06	11.28	3.12	10.30	3.50
Total mark-ups (%)	8.19	0.04	11.47	4.99	12.84	4.13	11.65	4.41

The profit margin of egg traders was estimated using the reported purchase price, marketing cost (transport and labour) and selling prices. On average, egg traders generated NGN58.4 per crate profit (Table 42). The return generated in the Abuja market shed was higher than in Lagos and Port Harcourt market sheds. The estimated profit margins suggest that egg traders generate modest income from the egg trading activity.

Table 42: Marketing margins of egg traders

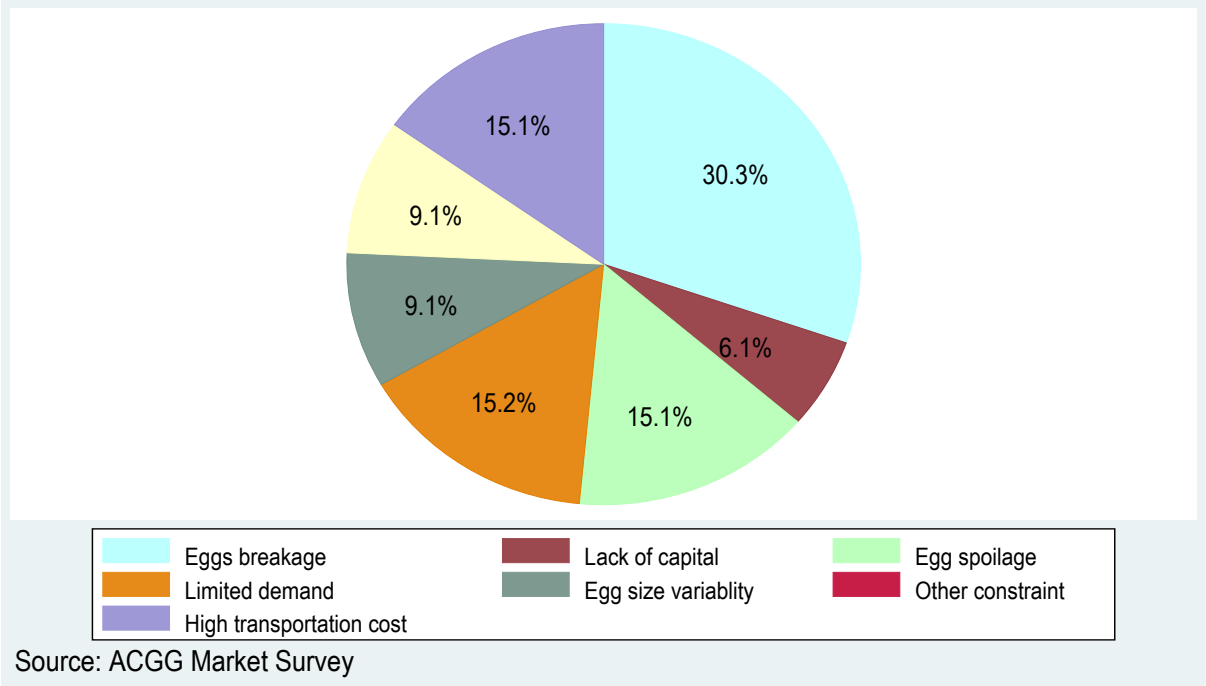
	Abuja		Lagos		Port Harcourt		Overall	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Buying price	820.0	4.7	849.4	105.3	901.9	99.9	867.6	97.8
Marketing cost	0.0	0.0	30.1	31.4	41.9	21.2	31.4	27.8
Selling price	887.2	5.4	942.5	138.7	994.5	106.8	957.4	118.4
Profit margin	67.2	0.7	63.0	31.8	50.7	22.6	58.4	26.1

8.3.6 Major challenges and opportunities

We asked egg wholesalers and retailers to indicate the main challenges associated with buying and selling eggs. Most traders reported eggs breakage and spoilage, inadequate transportation and storage facilities, and the variability of eggs size as main constraints (Figure 26). Some of the traders explained that because of egg breakage and spoilage, they usually experience great losses. In addition to handling and storage-related challenges, traders associated spoilage and breakage of eggs with the type of feeds used, type of breeds and other environmental conditions such as extremely hot weather conditions. Furthermore, few traders also reported limited access to credits and seasonal demand fluctuation as a challenge. Like the live chicken traders, limited access to credit seems to be a key constraint for egg traders.

Egg traders also explained existing opportunities in their business. According to sampled traders, their egg marketing participation supported their families' livelihood by generating income and creating employment opportunities. Moreover, some traders considered the presence of improved breeds, better management options and an increasing egg demand as an opportunity for the sustainability of their business.

Figure 26: Major challenges reported by egg traders.



Source: ACGG Market Survey

Egg traders suggested different policy options and interventions at the marketing and production level to further exploit available opportunities. Suggested interventions include improving egg storage and handling facilities and practices (44.4%), improving access to credit (33.3%), improving egg production and productivity (27.8%), enhancing road and transportation facilities (22.2%) and creating a better market linkage (16.7%). Improving egg storage and handling facilities would significantly reduce egg loss caused by egg breakage and egg spoilage. Moreover, some traders have pointed out the contribution of improving egg production and productivity, such as enhancing the feeding and management of layers to address some of the marketing challenges reported above.

9. Live chicken processors

Live chicken processors are the other most important value chain actors in the smallholder and commercial poultry value chain. The live chicken processors can be classified into two major categories: slaughter service providers/ local processors; and commercial processors. The commercial processors may include small-scale and medium-scale processors or large-scale integrated commercial processors. We only interviewed local slaughter service providers and small-scale commercial processors working along the smallholder and small-scale commercial value chains. These slaughter service providers mainly were found around the poultry marketing areas to provide slaughtering service to individual consumers, hotels/restaurants and other buyers. After buying chickens from traders or smallholder producers, some consumers gave them to slaughterers for slaughtering and cleaning services before taking it home. Most of the sampled slaughter service providers were involved in this business as full-time jobs.

As with the marketing of poultry products, peak and low processing seasons could be associated with the seasonality of poultry product consumption. Local processors considered November and December a peak processing seasons and June and July as a low processing seasons. Although there was variability in the number of chickens slaughtered across seasons and locations, on average, sampled respondents slaughtered 2-10 chickens per day. The most common activities may include slaughtering, scalding, de-feathering, removing head and legs, evisceration, washing, cutting, and packaging. Equipment such as knives and basins were used to undertake their cutting and cleaning activities. Slaughtering services may involve the cost of water, firewood/kerosene, house/shed rent and packing material. On average, they charged NGN100 and NGN200 per chicken during low and peak processing seasons, respectively. The local processors usually determine the processing fee, although they negotiate with their customers based on market conditions.

Slaughtering service providers explained limited access to processing places, inadequate processing equipment, limited access to water and seasonal variability in slaughtering service demand as the main challenges. While some slaughtering service providers undertook this activity in a simple house, others worked in open-air, even without any shed or permanent house. As a result, they could not access an adequate water supply for cleaning, and they did not have proper cutting and cleaning facilities. One respondent explained that he experienced repeated injury by hot water and other damages due to the absence of essential facilities. Some of the observed slaughtering facilities were in poor condition regarding location, hygiene and sewage system. Despite the above challenges, the slaughtering service has created employment opportunities for some of the workers in the country. Sampled respondents consider their business a valuable source of income and employment to support their households' livelihood. Nevertheless, they suggested strong support from the government and other organizations to enhance the quality and safety of the service. For instance, one of the slaughtering service providers working in an open field suggested availing proper slaughtering sites and improved slaughtering equipment as interventions to exploit the business opportunities in the sector.

The small-scale commercial processors buy live chicken from different producers and process and sell the meat to local consumers. Like other value chain actors, these processors reported December and April as peak processing and selling months. Small-scale commercial processors obtained their supply from smallholder producers, small-scale commercial

producers, and sometimes large-scale commercial producers. Some of them got supplies from their farms or retailers and wholesalers. Sampled respondents buy 90–900 chickens during peak processing months. Both producers and processors, through negotiation, determined the price of live chickens. Bodyweight was the key criterion to determine the price of live chickens. Some processors also considered the type of breeds and the health of chickens as additional criteria. Usually, a chicken must reach a minimum selling weight for processing. The number of processed chickens depended on the processor's capacity, market condition and processing facility location.

Small-scale processing activity involves variable and fixed costs such as hired labour, electricity, water, transportation, packing material, fuel and firewood. The fixed cost includes depreciation on fixed assets such as houses, slaughtering equipment, cutting and cleaning equipment, cold storage/chilling equipment and packing equipment. Moreover, they also pay government tax and interest for operating capital. Small-scale processors supplied the processed meat to different customers, including individual consumers, restaurants/hotels and retailers (supermarkets and local shops). The processors determined the selling price based on the price of live birds and processing costs. Some of the processors were members of poultry production and marketing-related associations.

We asked small-scale processors about the most critical constraints in their business. Accordingly, limited access to processing and storage facilities, high cost of processing, high transportation cost, power outage, limited access to finance and seasonality of meat demand were the main challenges reported by processors. Sampled processors suggested strong government support and favourable policy environments to enhance the contribution of processing activity in transforming the traditional smallholder poultry production to semi-intensive and small-scale commercial production. Policy interventions may include improving access to credit and supporting different value chain actors such as producers and input suppliers. For instance, one of the sampled respondents explained the negative effect of increasing live chicken prices on his business, resulting from higher production and marketing costs. A higher live chicken price usually results in an inflated price of processed meat for most consumers, which would create limited market demand. Other researchers have documented the need for policy attention to enhance the live bird processing sector in the country (Adeyanju and Ishola, 2014, Oladiran and Kabir, 2015, Fasanmi et al., 2018).

The poultry processing business has multiple contributions to enhance the competitiveness of the value chain. In addition to income generation and creating employment opportunities, it makes immense contributions towards improving the efficiency of the value chain. For instance, one of the sampled respondents indicated that the processing activity had improved the efficiency of his farm by minimizing losses associated with inadequate market demand. According to this respondent, when there was limited market demand for a live chicken and could not sell, he would process the birds and sell the meat when there is a better market. This reduces the cost of production by minimizing the additional feed and other variable costs required to keep the chicken for more days. Sometimes broiler farms experience a higher cost of production or even significant loss due to lack of buyers after the recommended growth stage. Given the seasonality of meat consumption and limited local markets in rural areas, processing firms would have a crucial role in improving smallholder poultry value chains' production and productivity.

10. Business opportunities along the chicken value chain

Increasing demand for poultry meat and egg consumption; inadequate domestic supply; limited supply and access to inputs such as feed and vaccine; limited access to markets and seasonal demand; and underdeveloped value chain coordination and integration create multiple business opportunities along the value chain. The most significant proportion of poultry producers in the country, smallholder producers, demands various services and support to enhance production and productivity. Efforts to improve the sector's productivity would generate business opportunities that can be categorized into input supply and delivery, small-scale commercial production, and processing and slaughtering services.

10.1 Input supply and delivery

Smallholder producers have a strong desire to enhance their production and productivity. However, limited access to inputs such as DOCs, feed and vaccines and disease treatment drugs has remained the crucial production constraint. Moreover, the supply of some inputs is highly concentrated in urban areas, and smallholder producers in rural areas have limited access. This shows available opportunities to develop new business models to deliver different inputs. Based on our observation, along the smallholder value chain, business opportunities in input delivery may include establishing local hatcheries, expanding mother units, introducing local feed mills/mixers and introducing innovative health services.

Local hatcheries: Traditional chicken production depends on broody hens for chick production with less than ten chick production potential per cycle. Naturally, a hen has limited brooding capacity, which has a strong negative effect on the overall production and productivity of smallholders' flock. Existing large-scale commercial hatcheries are found around urban centres, where most smallholder producers have limited access. Due to poor road infrastructure and inadequate transportation facilities, chicks' distribution from urban to rural areas results in significant loss due to mortality and physical damage. Moreover, despite smallholder producers' diverse preference for different chicken breeds, large-scale commercial hatcheries supply few strains that may not be suitable for different agro-ecology. This shows significant unmet demands in the rural areas and requires devising sustainable strategies that enhance the supply of farmers preferred and locally adapted vigorous chicks. Therefore, introducing cost-efficient and easily accessible local hatcheries that supply different chicken strains would create viable business opportunities.

Mother units: Due to inadequate capacity and limited resources at the smallholder level, raising chicks at earlier ages is the main challenge in traditional and hatchery-based smallholder production systems. Suppling vigorous chicks or pullets that adapt to a village-based sub-optimal management system enhances smallholder production and productivity in various ways. This requires locally available commercial brooders that raise chicks for certain days with intensive care and management systems. Therefore, introducing dynamic locally available mother units that brood locally adapted and farmers-preferred chicken breeds creates excellent business opportunities for unemployed youth and women in rural and peri-urban areas.

Local feed mixers: Feed is also a major prerequisite to transforming the low-input low-output production system into a high-yielding production system. Nevertheless, inadequate feed supply has become a recurring constraint in the traditional and improved chicken production system. As shown above, limited access to feed and inadequate feed quality are the main challenges reported by most actors along the smallholder and commercial poultry value chains. Moreover, most of the existing feed mills are found in urban areas, and the largest proportion of smallholder farmers have limited access to these feed supplies. This requires introducing locally available, easily accessible and affordable feed supply systems for smallholder and small-scale commercial producers in rural and peri-urban areas. This will create an opportunity for introducing a sustainable feed supply system in the value chain. The feed mixers can use locally available crops, industrial by-products, non-conventional feeds and some commercial feed proportions.

Health service providers: Mortality of birds and disease outbreaks are the primary production and marketing challenges reported by most smallholder producers and marketing actors. Producers had a stringent complaint about the efficacy of vaccines and treatment drugs. Higher disease incidence and inefficiency of existing health service provision portray the gap in demand and supply of health services. This could be a great business opportunity for unemployed veterinarians and other community-level health service providers to provide innovative health packages to the public and private sectors. Introducing community-based health service business models has an irreplaceable role in transforming the traditional production system into an improved and competitive production system.

10.2 Small-scale commercial production

Increasing the consumption of poultry products requires transforming existing low productive traditional/backyard production systems to semi-intensive or intensive commercial production systems. The economic feasibility analysis reported above suggests the viability of an improved breeds-based semi-intensive production system under smallholder management conditions. Therefore, small-scale semi-intensive or intensive production would be a viable business opportunity for unemployed youth and women in rural and peri-urban areas.

10.3 Processing and slaughtering services

Increasing demand for poultry products in urban areas requires increasing production and productivity and needs better marketing strategies, including processing, storage and distribution systems. Strategies to address the main marketing challenges reported by producers and traders involves introducing improved processing and slaughtering services. This helps move poultry products easily from place to place, reduce marketing costs and reduce product losses associated with transportation and maintenance. Therefore, expanding small-scale processing facilities that supply fresh products to customers would have significant economic and non-economic benefits. According to Silverside and Jones (2011), small-scale processing facilities can be established with modest costs and better slaughtering and storage facilities.

The business opportunities mentioned above have multiple contributions to enhance efficiency and effectiveness by addressing input delivery and marketing bottlenecks reported by most actors. This improves the livelihoods of smallholder producers by improving their capability to use available assets (human, social, natural and physical), reducing their vulnerability to production shocks and seasonality of incomes, and increasing food availability. The additional employment and job opportunities created by the introduced value chain actors and improved production and productivity significantly contribute to poverty reduction, food security and rural livelihood diversification. This shows the potential contribution of transforming the traditional production system to 2030 Sustainable Development Goals (SDGs), specifically to no poverty, zero hunger, good health and well-being, and gender equity (UN, 2015).

11. Major lessons and recommendations

This brief assessment generates valuable insights into the production and marketing aspects of smallholder and small-scale commercial poultry production in Nigeria. Major lessons learned, possible research and development interventions, and recommended policy actions are summarised below.

- This study shows that there has been an increasing trend in using different inputs under the smallholder chicken production system, which may contradict the conventional knowledge on limited or absence of external inputs use. Observed changes in input use depict smallholder producers economic interest in the production system and the need for introducing locally adapted and high yielding improved breeds that respond to better use in inputs. Introducing locally adapted improved breeds make the production system more sustainable and help to exploit numerous opportunities in the future.
- Smallholder chicken producers in rural areas have limited access to input and output markets compared to commercial producers. Hence, research and development interventions aiming to improve smallholder chicken production and productivity should integrate access to marketing opportunities as a critical component. Marketing interventions may include improved access to the central market, improved physical market infrastructure and facilities, access to market information and finance, products standardizing and grading, products collection and distribution, and value addition through processing, packing and storage. Sustained gain from improved technologies adoption and better management practices will be realized if there is a better market for inputs and outputs.
- Smallholder producers' production and marketing challenges could be directly or indirectly associated with limited vertical and horizontal coordination along the value chain. Given their limited access to market information and their smaller production volume, smallholder producers usually accept prices offered by their buyers. This puts smallholder producers at a competitive disadvantage compared with commercial producers, who have better access to information and central markets. Hence strengthening smallholders and other actors' coordination and linkage through different strategies such as producers' association, traders' association, and inputs supply and production agreements have an essential contribution. This would enhance the competitiveness and efficiency of the value chain by improving productivity and product quality, reducing costs and risks, building trusts, sharing market information, and creating a reliable supply of inputs and outputs.
- Under current conditions, the commercial production sectors have greater expansion prospects and better economic returns than indigenous breeds-based smallholder production. Unless the productivity of smallholder chicken production is improved, in the future, faster growth of the commercial sector would challenge the sustainability of smallholder production that supports the livelihood of millions of resource-poor households in rural and peri-urban areas
- Smallholder and commercial producers and marketing actors reported disease as their primary production and marketing challenges. Despite frequent vaccinations and treatments use, some producers have repeated experience in vaccination and treatment failures. It looks that poultry disease would remain the primary production and marketing constraint along the value chain, including during product marketing. The failures of vaccines and treatments seem to exasperate the research and development efforts aimed to enhance smallholder chicken

production and productivity. Widespread concern posed by disease incidence and drug failure may suggest the need for developing innovative disease prevention and treatment models along the value chain.

- Although most of the producers involved in mother unit farms are profitable, variations in the level of profitability indicate existing gaps to enhance the performance of these farms. Differences in economic performance could be associated with variation in the type and amount of inputs used, management systems and market opportunities. Therefore, enhancing the performance of these farms need further research on existing practices in input use, production management, marketing strategies and entrepreneurial skills of operators.
- Access to finance is the other primary production and marketing constraint along the smallholder and small-scale commercial poultry value chains. This has restricted producers' capacity to invest in technologies, production inputs and traders' capacity to collect and distribute products. Improving access to finance requires an integrated effort of different stakeholders such as government, donors, and financial institutions and developing a sustainable lending approach and delivery system.
- Smallholder producers' experience adopting TAIBs-based production systems shows that these breeds could generate significant economic and social gains under smallholder management conditions. The economic performance analysis results indicate that improved chicken production's economic gains are highly dependent on flock size. Furthermore, evidence from poultry products marketing practice shows significant seasonal variability in the consumption of poultry products. This suggests the need for extensive research on optimal flock sizes for smallholder production that would consider producers' capacity and available market opportunities.
- Interventions that aim to transform traditional smallholder chicken production to TAIBs-based semi-intensive production have significant social, economic, and environmental gains. Socio-economic gains achieved through adopting TAIBs may include increased household income, added employment opportunities, and enhanced education and health outcomes of household members. However, multiple productions and marking challenges reported under existing smallholder and small-scale commercial production systems suggest developing an inclusive and dynamic business model to address various challenges along the value chain. The business models should integrate innovations in improved genetics delivery, collective actions and capacity building, enhancing access to locally available and low-cost inputs, improving access to markets, women empowerment and nutrition education.

Study limitation

Due to time and resource constraints, we considered only three main market sheds in Nigeria, and the size of sample respondents was small for some of the marketing actors. The interpretation of some of the specific quantitative indicators should therefore consider these limitations.

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