Structure and profitability of poultry value chains in Tanzania

First draft

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Contents

1 Introduction

The Bureau of Food and Agricultural Policy (BFAP – South Africa) and Sokoine University of Agriculture (SUA – Tanzania) have undertaken an assessment of the poultry value chain in Tanzania. The work is in collaboration with the International Livestock Research Institute (ILRI – Kenya), and the International Food Policy Research Institute (IFPRI – USA) and it forms part of a larger ILRI project, referred to as the African Chicken Genetics Gains (ACGG) project that is working to develop more resilient and productive strains of chickens for meat and egg production, primarily targeting local markets. The ACGG project is a five-year multi-partner, multi-country project that began operation in November 2014 with an investment of over 14 million dollars and is being implemented in Ethiopia, Tanzania, and Nigeria. The project has been successful in testing indigenous chicken breeds and enhancing access of smallholder farmers to more productive, agro-ecologically appropriate and farmer-preferred chicken strains.

The scope of this study included:

1. An end-to-end scan of the "as is" poultry value chain in Tanzania with an updating of all relevant summary data.
2. An analysis of the current poultry value chain footprint in Tanzania, including the articulation of the key drivers of the current value chain structure and economic base for example current market size, product flows, and prices.
3. A quantitative and qualitative (in field) approach to inform (1) and (2), utilizing in country resources and a localized approach.

The key findings of the study present a detailed assessment of the structure and profitability of three distinct chicken value chains for small and medium enterprises (SME) and larger-scale operators. The immediate goal of the project is to unpack product flow, compare margins and identify market opportunities where SMEs and farmers could be competitive and expand production. The broader goal is to enhance the chicken industry's contribution to the Tanzania's national goals of job creation, poverty reduction and improved diet quality.

The market-led value chain analysis approach this is used in this study forms part of a combination of models, analytical tools and a geo-spatial platform that BFAP has developed over the past fifteen years. In a recent pilot study, BFAP collaborated with IFPRI and SUA to formalise a combination of quantitative and qualitative tools into a replicable approach that brings together ex-ante economywide and sector modeling, value chain diagnostics and market analysis combined with spatial analysis to assess and recommend policy and public investment priorities for enabling country-level inclusive agricultural transformation.

2 Context

2.1 Global context

Over the course of the past decade, meat consumption globally increased by an annual average of almost 2%. Growth was supported by rapid growth in per capita income in developing economies and as the most affordable source of animal protein, poultry meat consumption grew faster than any other meat type. From 2007 to 2017, poultry consumption increased by an annual average of just over 3%. Consequently, it has overtaken pork as the most consumed meat globally (Figure 1). Over the next 10 years, the OECD-FAO projects growth in poultry consumption to slow to an annual average of 1.4% per annum, as meat consumption in many developing regions starts to approach the levels observed in developed countries. Increasing affluence in these developing regions is expected to result in consumers diversifying their meat consumption mix, supporting growth in beef and

sheep meat consumption. Nonetheless, by 2027, poultry is still projected to remain the most consumed meat type, constituting 38% of total meat consumption.

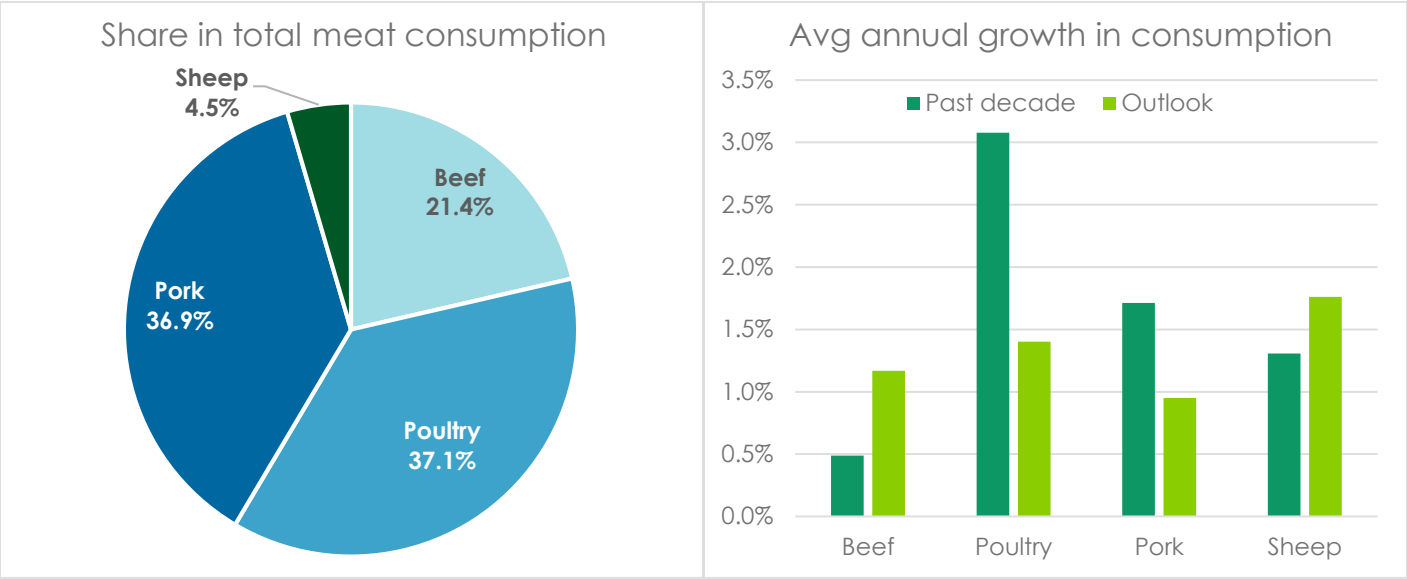

FIGURE 1: CONTRIBUTION OF SPECIFIC MEAT TYPES TO GLOBAL CONSUMPTION (A) AND GROWTH IN CONSUMPTION OF SELECTED MEAT TYPES OVER THE PAST DECADE (B)

The past decade has been characterised by significant swings in agricultural commodity prices. Important factors supporting prices was increased demand with the introduction of the biofuel sector, rapid economic growth in China which supported the demand for meat and feed products, as well as consecutive droughts in the USA between 2011 and 2013, which restricted supply. The drought conditions in the USA resulted in significant beef herd liquidation, which supported prices for all livestock products. At the same time, it resulted in major increases in feed grain prices, which resulted in severe pressure on profitability of intensive livestock sectors such as pork and poultry. Normalisation in weather conditions in recent years initiated a cycle of low feed prices, which improved profitability of livestock producers – but sectors such as beef have a long production cycle and given the time required for supply to respond, beef prices only returned to a downward cycle in 2016. In the poultry sector, where production cycles are shorter and supply able to respond quicker, prices declined as early as 2014 (Figure 2).

Over the course of the next decade, the OECD-FAO (2018) projects a largely sideways trend in meat prices (Figure 2), under the assumption of stable weather conditions. Demand remains strong, even if growth has slowed from the past decade and while prices have declined, feed prices are also in a low cycle, resulting in profitable and expanding livestock production.

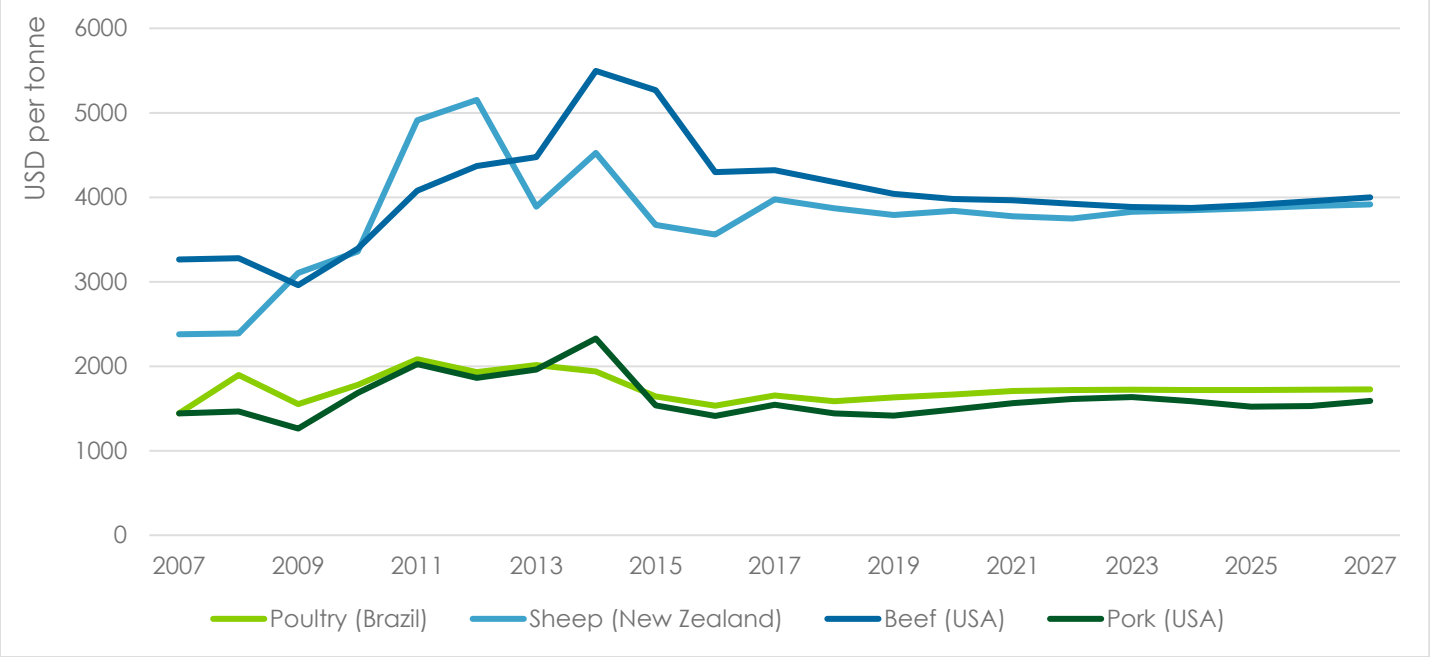

FIGURE 2: HISTORIC AND PROJECTED WORLD REFERENCE PRICES FOR SELECTED MEAT TYPES

Source: OECD-FAO, 2018

Poultry production globally is highly concentrated, with the United States of America (USA), Europe, China and Brazil accounting for 62% of global production volumes between them. By contrast, the entire Sub-Saharan Africa (SSA) accounts for less than 3% of poultry production in the world. The largest share of SSA production is attributed to South Africa, which supplies 1.6% of global volumes, with Tanzania accounting for merely 0.1% of global production volumes (Figure 3).

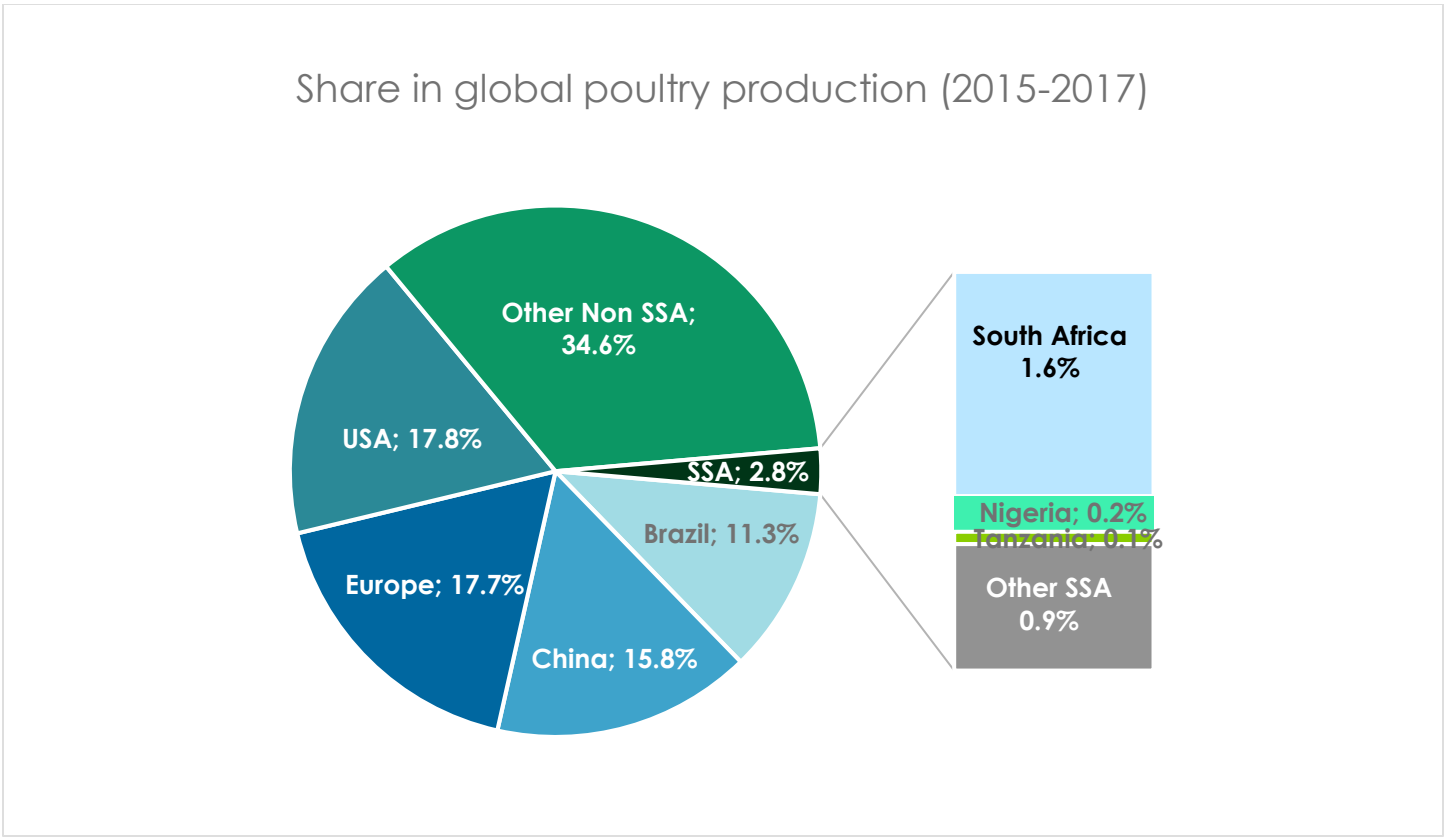

FIGURE 3: SHARE OF SELECTED COUNTRIES IN GLOBAL POULTRY PRODUCTION - AVERAGE 2015 – 2017

Source: OECD-FAO, 2018

Despite rapid economic growth over the past decade reaching levels in excess of 5 percent, growth in Tanzania has mainly been very concentrated from a very low base and per capita income levels remain low in the global context. In 2017, the World Bank indicated that real per capita income in Tanzania (in purchasing power parity USD terms) was merely 5% of that observed in the USA. These low-income levels affect consumers' ability to include meat products in their diet and while the United Nations Food and Agriculture Organization (FAO) recommend a minimum per capita meat consumption of 50kgs, Tanzanian consumers, on average, consume only 11kg per capita per annum. Poultry represents a small share of this and on average, between 2015 and 2017, Tanzanians consumed approximately 2 kg of poultry per person per year. This compared to 35 kg per person in South Africa and 47 kg per person in the USA.

Whereas poultry has been the preferred meat type globally, beef consumption exceeds that of poultry in Tanzania. This is a result of both availability, as well as relative costs, as chicken typically trades well below beef globally. In Tanzania however, less productive poultry production, combined with restrictions on imports and exceptionally high feed costs, has resulted in poultry prices trading much closer to beef. In periods of short supply, poultry prices have even exceeded that of beef. This would suggest that, rising income per capita, combined with a reduction in poultry prices, could result in significant expansion in poultry consumption.

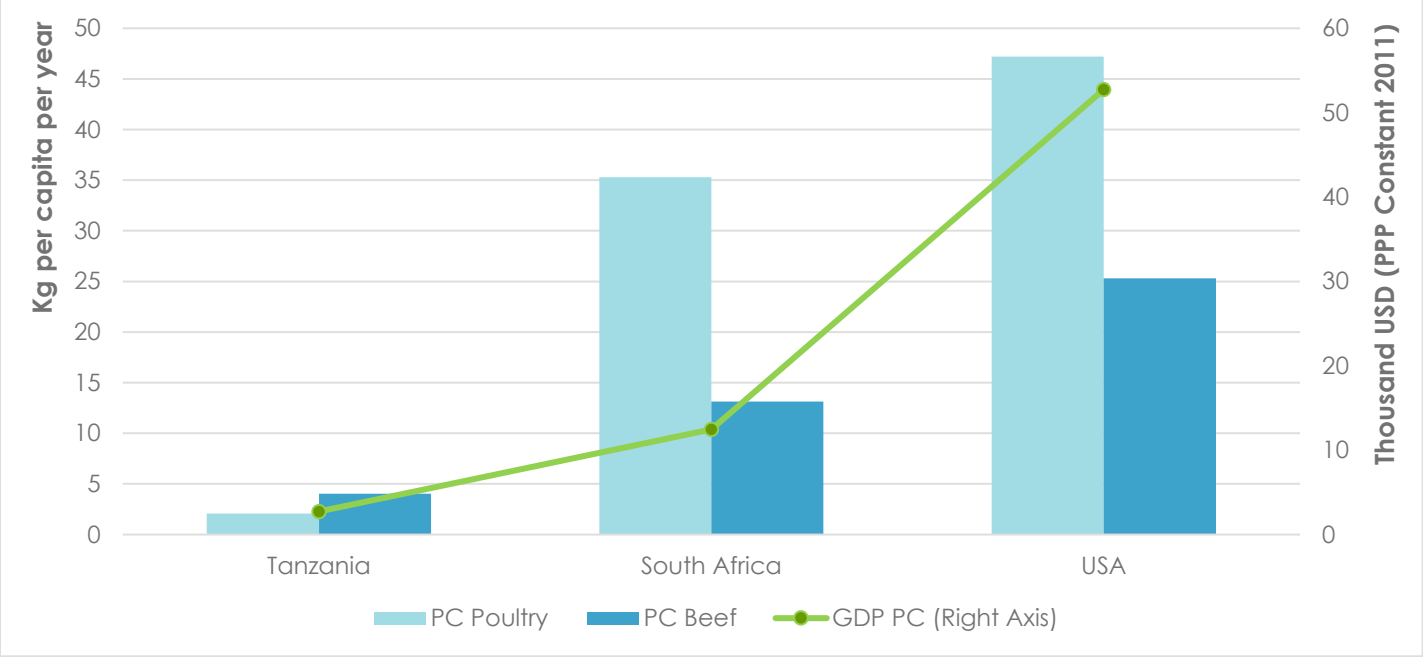

FIGURE 4: PER CAPITA INCOME, AS WELL AS POULTRY AND BEEF CONSUMPTION IN TANZANIA RELATIVE TO SOUTH AFRICA AND THE USA

Source: Compiled from OECD-FAO, 2018; Tanzania National Bureau of Statistics, 2017 and World Bank,2018

2.2 Tanzania's poultry industry

The majority of the Tanzania population (80%) are farmers who live in rural areas and depend on agriculture as their main economic activity. Agriculture in Tanzania contributes approximately 29% to Gross Domestic Product (GDP) and is largely smallholder based, with most (60%) of the households having farms of less than two hectares and few (20%) with two to three hectares (World Bank et al., 2011). Livestock production is one of the major agricultural activities and an integral part of the Tanzania's economy. It contributes about 7% of the gross domestic product (GDP), with 1.8% attributed to poultry. In addition to its economic contribution, the livestock subsector also supports dietary diversity through the provision of meat, milk, milk products and eggs for consumption (Njombe and Msanga, 2009; United Republic of Tanzania (URT), 2010; IFPRI-RIAPA, 2016). Meat, fish and eggs account for 21% of food consumption in Tanzania, with a further 5% attributed to milk and dairy products (IFPRI-RIAPA, 2016)

In Tanzania, poultry farming plays an important role in both urban and rural settings in terms of food security, source of income and in meeting other social obligations such as dowry and rituals. The poultry sector has a huge potential for growth considering land availability to grow grains and soya for poultry feeding. The outbreak of Avian Influenza in the mid-2000 attracted government interventions into the sector leading to importation of poultry and its products into mainland Tanzania been banned. The Private Sector Industry based Organisations (PSIOs) such as the Tanzania Poultry Breeders Association; and the Tanzania Commercial Poultry Association lobby for government interventions and have been keeping pressure on the government not to allow imports. The key argument is that imports would have a major negative impact on the development of the local industry. Differences in agricultural trade policies between Tanzania mainland and Zanzibar lead to illegal importation of poultry meat in Tanzania mainland.

Poultry production in Tanzania comprises both commercial (broilers and layers) and traditional systems, which rely on indigenous breeds, as well as improved, dual purpose breeds mainly kept in a free range system. Commercial poultry production is mostly practised in urban and peri-urban areas. Traditional poultry production is the largest, contributing about 70% of the flock and supplying the bulk of poultry meat and eggs consumed in rural areas and 20% in urban areas (Boki, 2000; URT, 2006). Indigenous poultry is regarded in Tanzania as an important source of poultry mainly in the rural area and assists food security and sustainability. It is also not uncommon that the consumers prefer the taste of these chickens and are willing to pay a premium for the meat and eggs. Production is focused mainly on own consumption. The commercial poultry sector contributes 80% of poultry meat and eggs consumed in urban areas.

Tanzania's National Bureau of Statistics (NBS) (2016) notes that the majority of the Tanzanian population keeps some chickens. The national panel survey conducted in 2014/15 indicated that 59% of livestock producing households owned chicken (NBS, 2016). The national flock is estimated at approximately 40 million birds, of which 38 million are indigenous breeds, 1.8 million layers and 0.9 million broilers. These numbers represent a snapshot at any point in time however and while the indigenous flock has remained fairly constant over time, broiler numbers have been increasing. Broilers also typically produce more than 1 cycle a year industry estimates suggest that 32 million broiler birds are produced annually. This would require 34 production cycles if the estimates from the NBS related to broiler numbers at a single point in time is correct. This suggests that broiler production is severely underestimated by the NBS numbers. The nature of the broiler production system suggests that it would be easy to under estimate production through a snapshot survey at any point in time.

	Number (Thousand units)	Percentage of total
Chicken	40820	43%
Cattle	25654	27%
Goats	18935	20%
Sheep	5574	6%
Pigs	1746	2%
Other	1509	2%
TOTAL	94239	100%

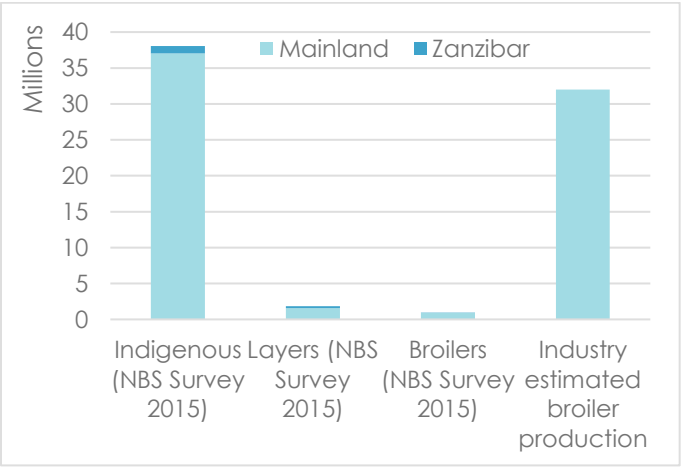

FIGURE 5: LIVESTOCK NUMBERS IN TANZANIA (A) AND THE COMPOSITION OF THE NATIONAL CHICKEN FLOCK (B)

Source: Tanzania National Bureau of Statistics, 2016

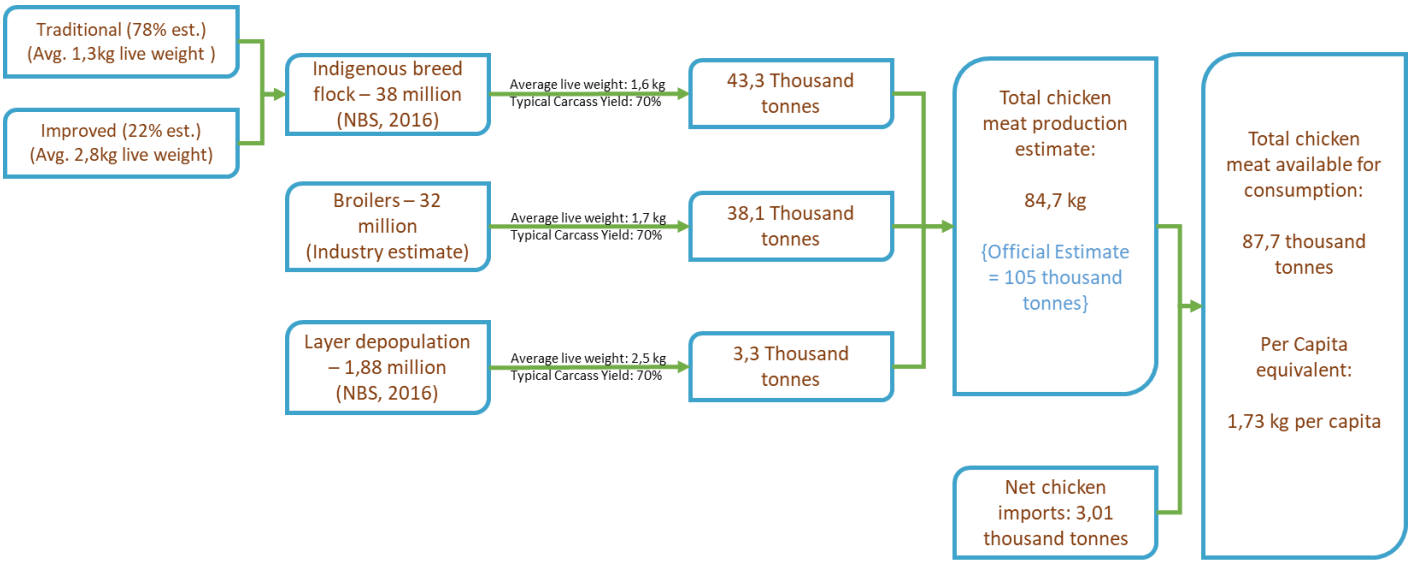

FIGURE 6: TANZANIA POULTRY PRODUCTION ESTIMATE

Source: Tanzania National Bureau of Statistics, 2016, own calculations

Chicken production is distributed across the country, with the highest density of birds in the regions surrounding Dodoma, Kilimanjaro and Dar Es Salaam (Figure 7). The largest share of the national flock is found in Tabora (6.5%), Shinyanga (5.2%), Mwanza (5.2%), Morogoro (5.1%), Geita (5.1%) and Dar es Salaam (4.5%). The under estimation of broiler numbers in the NBS survey numbers reflected in Table 1, the share of total production attributed to urban and peri-urban regions is likely significantly higher.

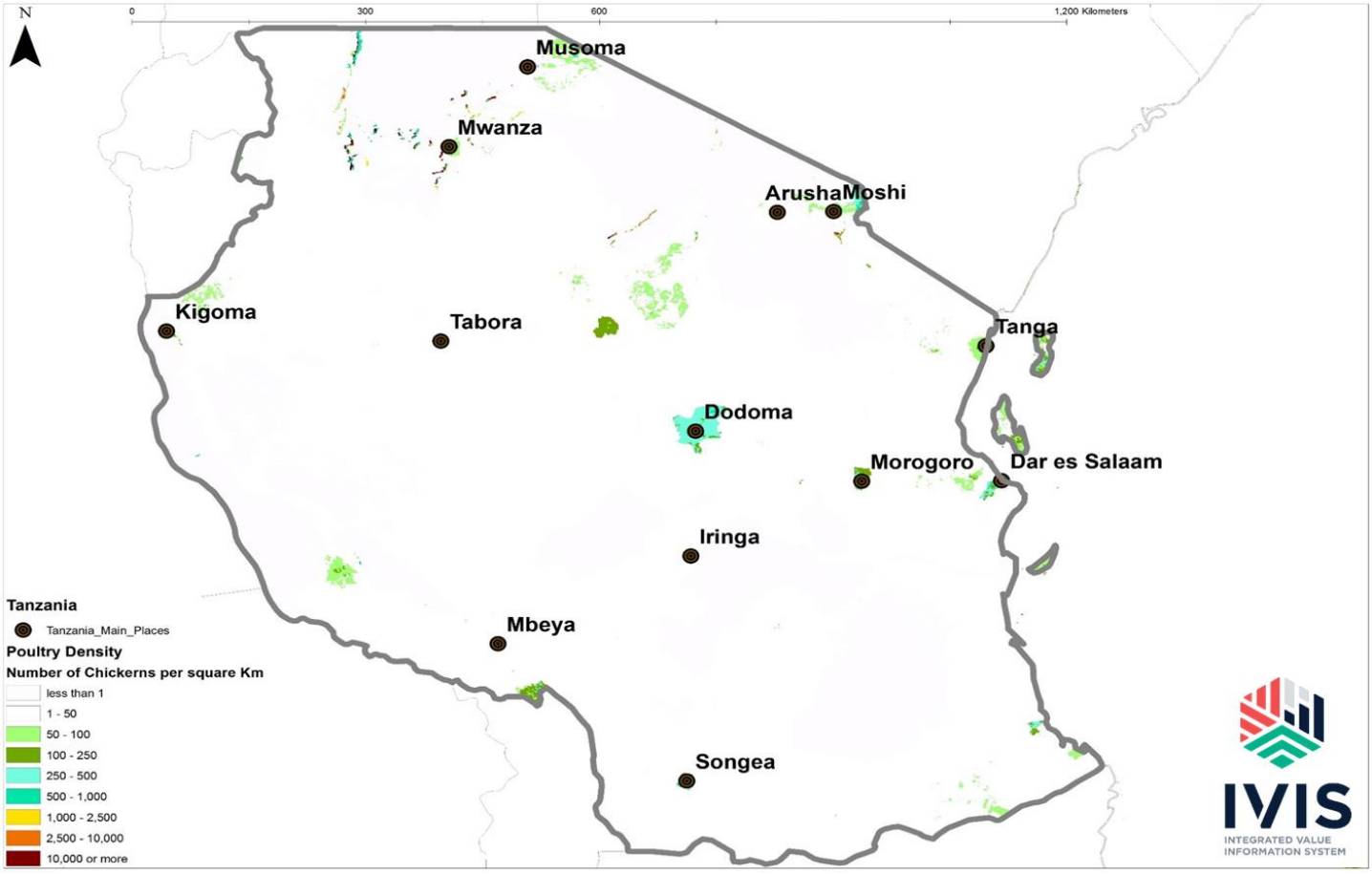

FIGURE 7: SPATIAL ILLUSTRATION OF POULTRY PRODUCTION IN TANZANIA

SOURCE: SPAM (2005), TANZANIAN MINISTRY OF AGRICULTURE, FOOD SECURITY AND COOPERATIVES (2016) IIASA & FAO (2010), IVIS (2018).

TABLE 1: CHICKEN NUMBERS IN TANZANIA, DISAGGREGATED BY DISTRICT

	Indigenous	Layers	Broilers	Total	Share in National Total
Dodoma	1208459	355739	97487	1661684	4%
Arusha	1045960	111288	0	1157248	3%

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Kilimanjaro	1622672	116513	17211	1756395	4%
Tanga	1707878	S	S	1741660	4%
Morogoro	1968875	66624	49969	2085468	5%
Pwani	1581651	55920	27960	1665531	4%
Dar-es-salaam	1596258	134773	96306	1827338	4%
Lindi	1140269	S	S	1140612	3%
Mtwara	1450682	S	S	1451219	4%
Ruvuma	1442164	0	0	1442164	4%
Iringa	1489083	0	0	1489083	4%
Mbeya	2518828	0	5854	254782	1%
Singida	1469356	66079	61836	1597272	4%
Tabora	2490830	145862	0	2636692	6%
Rukwa	566814	295200	198962	1060977	3%
Kigoma	658382	0	0	658382	2%
Shinyanga	2099219	25980	0	2125199	5%
Kagera	1090950	56841	0	1147791	3%
Mwanza	2029335	31568	59566	2120469	5%
Mara	1692949	12510	51611	1757070	4%
Manyara	1211649	2784	1113	1215546	3%
Njombe	841599	0	0	841599	2%
Katavi	556590	0	0	556590	1%
Simiyu	1567386	22084	155523	1744993	4%
Geita	1980254	36000	62065	2078319	5%
Mainland	**37028092**	**1570406**	**885584**	**39484082**	**97%**
Kaskazini-Unguja	169379	31404	10927	211709	1%
Kusini Unjuja	192056	11146	14543	217745	1%
Mjini Magharibi	283224	142614	19993	445831	1%
Kaskazini-Pemba	196898	77831	0	274729	1%
Kusini-Pemba	186261	0	0	1826261	4%
Zanzibar	**1027819**	**262995**	**45463**	**1336276**	**3%**
National	**38055910**	**1883401**	**931046**	**40820358**	**100%**

Source: Tanzanian National Bureau of Statistics, 2015

The bulk of chicken production in Tanzania is attributed to small-scale producers, According to the large scale, commercial producer survey conducted by the NBS in 2016, the total number of chicken reared on large-scale farms was 277 thousand, 179 thousand of which are broilers. This represents 19% of stated broiler production and less than 1% of total chicken production. Out of the total number of chicken kept on large scale farms, the largest number (192,519; 69 percent) was in Pwani, followed by Dar es Salaam (27,650; 10 percent), Iringa (14,000, 5 percent) and Tanga (11,166; 4 percent). It is, however, worth noting that with the in-country surveys that were undertaken for this study it became clear that significant investments in commercial broiler operation are currently taking place.

In 2016, national chicken production was reported as 102.4 thousand tonnes. When combined with the reported bird numbers (38 million indigenous birds, 1.8 million layers and 32 million broilers – as estimated by industry), this is indicative of an average carcass weight of 2.4kg per chicken, which is higher than reported in informal

discussions with poultry industry stakeholders in Tanzania. Discussions suggest that most birds are slaughtered at an average live weight of 1.2 to 2 kilograms, which would typically yield a carcass weight of around 1 to 1.4 kilograms. Improved, dual purpose birds such as Kuroiler or SASSO can grow heavier, up to 3.5kg at the end of the laying cycle, but these represent a fairly small share of total bird population. **Consequently, the average carcass weight calculation would indicate that, either the total production number is overstated, or alternatively, flock numbers remain understated, even after correcting broiler numbers to the industry estimate of 32 million.**

Despite of the discrepancy in the data, it is evident that chicken production in Tanzania has increased rapidly since 2006, by an annual average of 3.5%, but this remains below the 3.8% per annum growth in consumption (Figure 8 and Table 2). Having grown rapidly from 2001 to 2007, the introduction of Value Added Tax (VAT) on feed products was a significant additional cost to the broiler sector. This period co-incided with a substantial increase in global feed grain prices and hence broiler production stagnated towards 2010. When VAT was removed in 2010, it supported a substantial increase in production in 2011, before feed costs increased once more as a result of international price movements following consecutive droughts in the USA. While growth has returned in recent years, VAT was added to feed again in 2015, admittedly after maize prices had declined from 2013 highs, before being removed again in 2017 when prices spiked. This continuous introduction and removal of VAT has a significant impact on broiler producers, who use feed very intensively and introduces policy uncertainty into the market, which is not conducive to investment to increase production. The poultry sector has significant potential for growth considering land availability to grow grains and soya for poultry feeding.

Given that production growth has failed to keep up with consumption, imports have had to increase to supply the deficit. Though imports remain a small share of the total market, volumes have increased by an annual average of more than 50% since 2006, despite policy reflecting a ban on chicken imports. This ban only applies in mainland Tanzania and Zanzibar does in fact allow chicken imports. It has been suggested that chicken imported into Zanzibar often enters mainland Tanzania through informal channels.

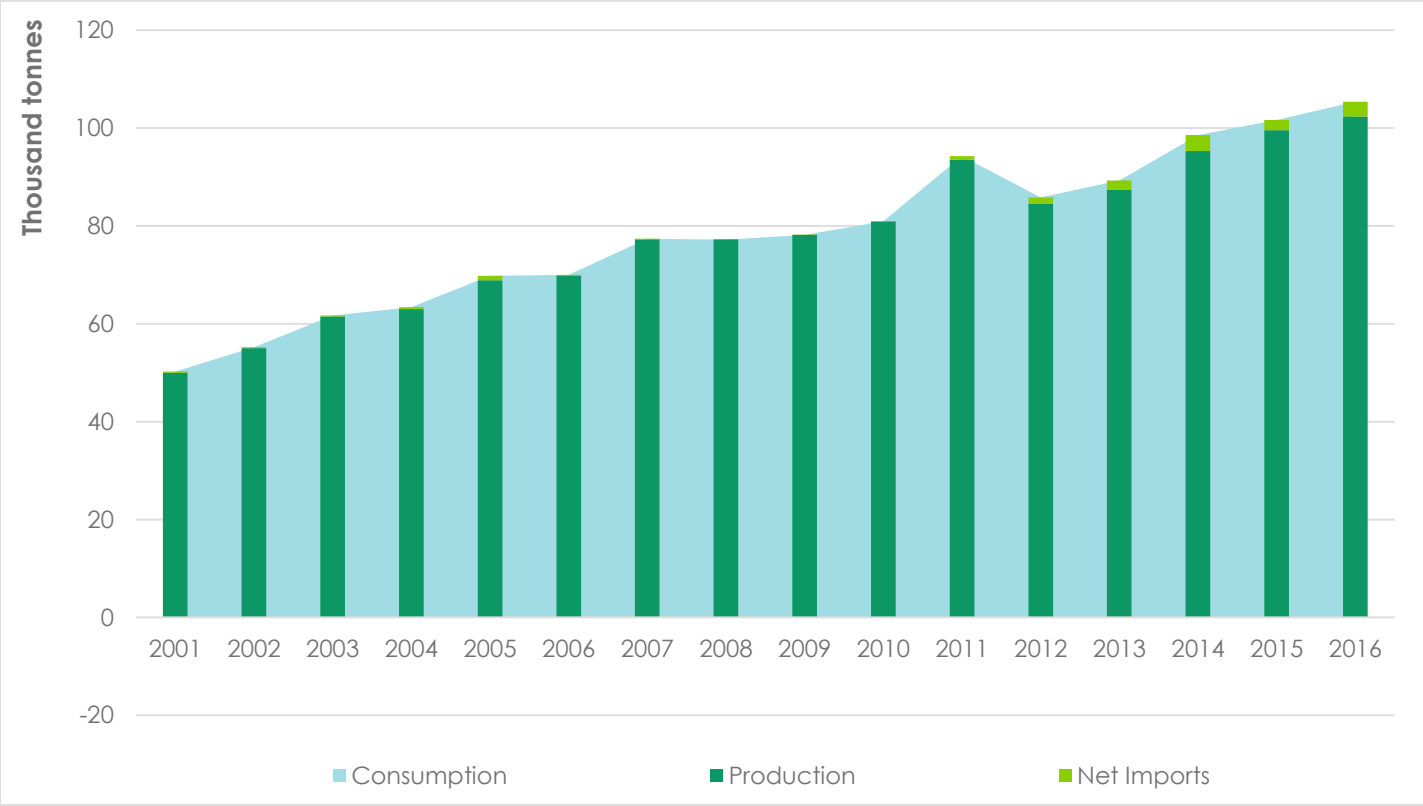


FIGURE 8: CHICKEN PRODUCTION, CONSUMPTION AND NET IMPORTS IN TANZANIA: 2001 – 2016

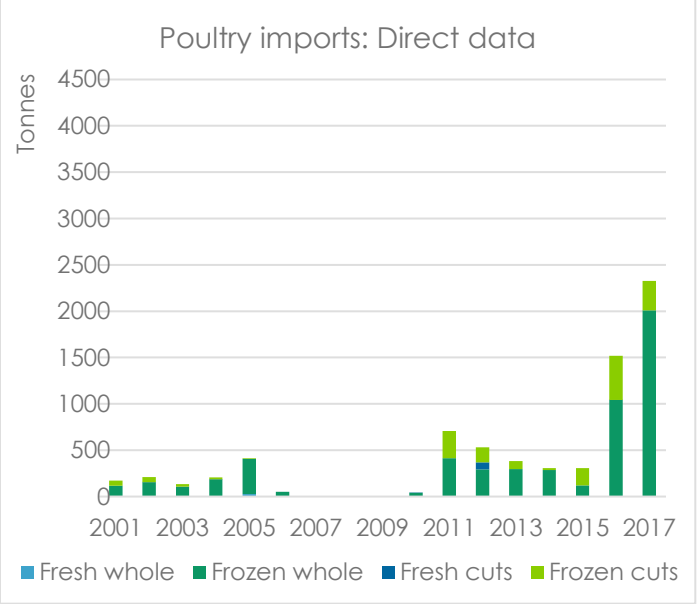
Source: Tanzania Ministry of Livestock and Fisheries, 2017; ITC Trademap, 2018

The outbreak of Avian Influenza in the mid-2000 attracted government interventions into the sector leading to a ban of imported poultry and its products into mainland Tanzania. The Private Sector Industry based Organisations (PSIOs) such as the Tanzania Poultry Breeders Association and the Tanzania Commercial Poultry Association lobby for government interventions and have been keeping pressure on the government to protect the industry against imports. The key argument is that imports would have a major negative impact on the development of the local industry. Yet, as previously mentioned, differences in agricultural trade policies between Tanzania mainland and Zanzibar lead to illegal importation of poultry meat in Tanzania mainland.

TABLE 2: POULTRY MARKET GROWTH RATES IN TANZANIA

	2014 - 2016	2006 - 2016	
	Absolute level (Thousand tonnes)	Absolute growth (Thousand tonnes)	Percentage growth per annum
Production	99.07	32.47	3.5%
Domestic Consumption	101.88	35.37	3.8%
Exports	0.00	0.00	0
Imports	2.81	2.90	57.0%

Figure 9 presents chicken volumes imported into Tanzania, disaggregated by tariff classification at Harmonised system (HS) 6 digit level. Figure 9a on the left illustrates direct data – reported as imports by Tanzania. Figure 9b on the right illustrates mirror data – thus exports reported by trade partner countries as destined for Tanzania. It is clear from the 2 figures that large discrepancies exist both in terms of total volumes and classification. Where direct data reports 319 tonnes of frozen cuts imported, mirror data has this figure at 3164 tonnes. What is clear from both figures however is that imports have increased significantly over the past few years. Even if this growth is from a small base, it comes at a time when formal imports into mainland Tanzania are banned and therefore only reflects volumes entering the country through Zanzibar. It provides an indication that production has been unable to keep pace with consumption growth and at the same time, that imports could grow rapidly if the ban is lifted without significant improvements to the competitiveness of domestic producers.



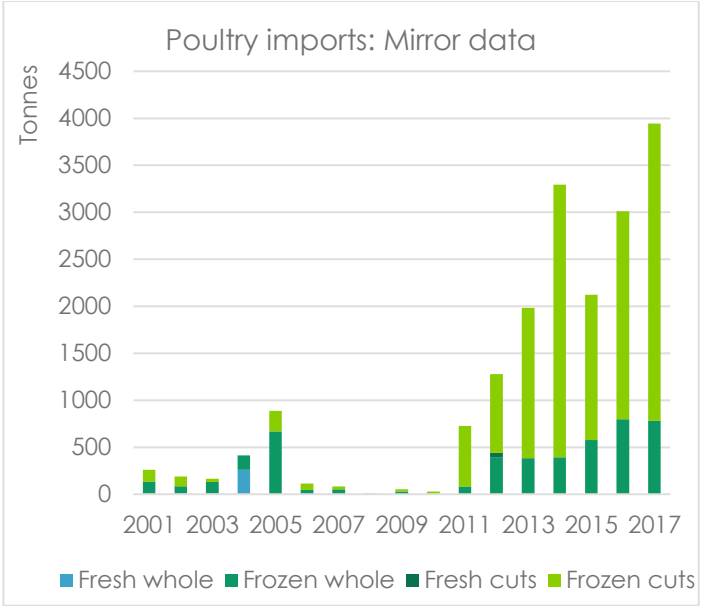


FIGURE 9: TANZANIAN POULTRY IMPORTS STATED AS DIRECT DATA (A) AND MIRROR DATA (B)

Source: ITC – Trademap, 2018

Figure 10 presents imports into Tanzania, disaggregated by country of origin. It indicates that much of the growth in imports is coming from the USA, followed by Brazil, the United Arab Emirates (UAE), Poland, Turkey, Russia and Ukraine. Between 2015 and 2017, on average 70% of total imports originated form the USA.

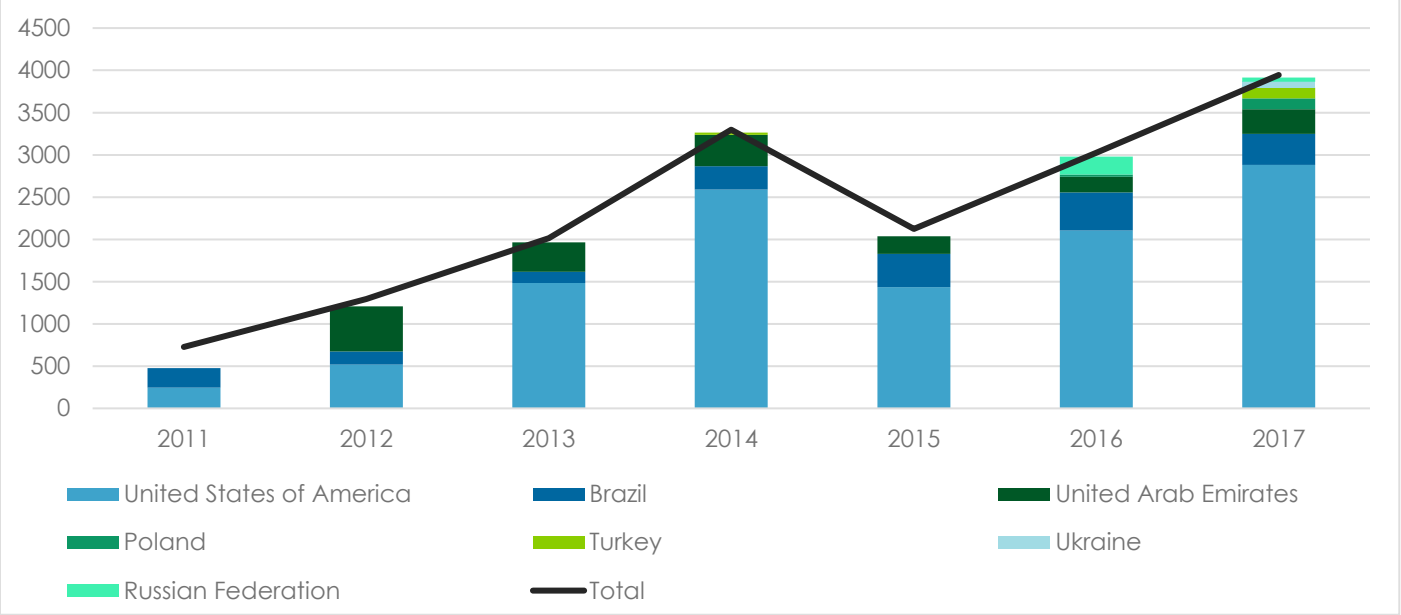


FIGURE 6: POULTRY IMPORTS INTO TANZANIA, DISAGGREGATED BY COUNTRY OF ORIGIN (MIRROR DATA)

Source: ITC – Trademap, 2018

Combining the production volumes reflected in Figure 8 and the trade volumes obtained from the mirror data in Figure 9b enables an estimation of annual chicken consumption in Tanzania. From 2006 to 2016, Tanzanian chicken consumption increased by an annual average of 3.8%, to reach an average of 100.9 thousand tonnes per annum between 2014 and 2016. This implies an average per capita consumption of 2.07kg per annum, which is well below higher income countries such as South Africa and the USA (Figure 4). While total consumption has increased rapidly, much of this growth is attributed to an expanding population and between 2006 and 2016, per capita consumption of chicken increased by an annual average of only 1.2%.

Multiple reasons can be identified for the comparatively low levels of chicken consumption in Tanzania. Production costs and consequently also the price of chicken remains high and where chicken is typically the cheapest source of animal protein in most parts of the world, prices are often comparable to beef in Tanzania. Consequently, it is often consumed by more affluent consumers. Growth in commercial broiler production in recent years has aided in reducing chicken prices, but particularly in rural areas, consumers show a preference for indigenous "Kienyeji" chicken, which is significantly more expensive than broiler meat. This preference has been associated with the perception that chicken produced in modern, commercialised systems is not healthy, as well as the taste of the meat being different. Taste differences can be attributed to differences in texture from a younger broiler bird, as well as the presence of fishmeal in feed rations late in the cycle. It has been noted by industry stakeholders that younger, urban consumers are more receptive of broiler consumption and particularly under younger consumers, chicken consumption is expected to increase over the next few years. Projected growth in income levels will also support increased chicken consumption, but improvements in productivity and lower production costs will be critical to reduce the cost of chicken relative to alternative meat types.

3 Value Chain Analysis

The value chain analysis is presented in three sections. The first section provides a value chain overview, which can also be referred to as a qualitative high-level value chain scan. The second section provides a detailed breakdown of the product flow through the various value chains. The third section focuses on the presentation of the gross margin analysis for each node in the value chain, and the last section provides a detailed analysis of the feed industry in Tanzania.

3.1 Overview of the poultry value chain

The structure of the current overall poultry value chain is presented in figure 10. Poultry production in Tanzania is dominated by indigenous chicken production mainly by rural dwellers and skilled farmers only supply a small share of the local market with layers and broilers. Indigenous chickens are characterized by very poor productivity, 3 laying cycles, 12 eggs per cycle and approximately 36 eggs per year. It is estimated that only 5% of the eggs are marketed and the rest are retained for hatching and household consumption. The hatchability of indigenous chicken is 60-65% with mortality rate of 45-70%. Indigenous chickens are kept in a free-range system with supplemental feeding mainly maize bran.

The commercial poultry industry includes breeder farms, hatcheries, layer and broiler farms, traders and processors. Broiler production normally has a cycle of 4 weeks. Producers indicated that beyond 4 weeks, margins reduce due to a weaker feed conversion ratio (FCR) and high feed cost. In the case of layers, the laying cycle starts after 21 weeks with a weight of 1.5 kg and the total cycle last for 630 days. The introduction of improved breeds like Sassa and Kuroiler that can produce a combination of meat and eggs but also have the ability to adapt to a typical scavenging free-range type of system offer a significant improvement above the traditional birds.

Producers are categorised into three groups. The first group are traditional primary producers (normally producing chickens for household consumption, largely local breeds. Small-scale village households produce mostly indigenous chicken (15% of marketed production; 51% of bird population). The indigenous chicken flock sizes ranges from 5-50. The maximum size for indigenous is 50 chicken because beyond this number it leads to negative impacts into the environment. The second group is for the semi-commercial producers who produce for dual purposes both household consumption as well as for business purposes. The last group consists of commercial producers who normally produce for business purposes. Commercial producers vary in scale of production and exist as small-scale producers owning less than 10,000 chicks, medium scale producers owning between 10,000 up to 50,000 chicks and large-scale producers owning more than 50,000 chicks. Medium and large-scale commercial producers are based in towns or close to urban areas given the fact that commercial production is capital intensive.

In recent years, Tanzania has seen in increasing investment in *vertically integrated production systems where* a company would typically control 90% of the value chain including the production of feed, chicks, broiler and layer production. There are also contract producers who are linked to large-scale commercial producers. They buy Day Old Chicks (DOCs), feeds and other inputs from large-scale commercial producers and sell live birds or chicken meat to large-scale commercial producers. Interchick Co. Ltd is an example of large-scale commercial producer with contract grower scheme and 90% of its meat supplies originating from its contract growers.

There exist two different contractual arrangements; firstly, producers are given inputs on credit at a reduced price (E.g. instead of paying $0.67/DOC, the price reduces to $0.54/DOC). They are offered DOCs, feeds and vaccines. Producers are initially required to deposit 75% of the total input costs and the other 25% are deducted when making payment for their supplies of chicken. Companies that participate in this chain estimate the total cost of all inputs (DOCs, feeds and vaccines) at $2.2/bird. The company also offers other services on credit. The key services offered are transport for live birds/chickens and slaughtering. Transport costs ($45 for 1500 birds for 61km) and slaughtering costs ($0.22/bird) are deducted after sales when other input cost payments are being finalized. The contracted producer sells slaughtered bird at an agreed price based on the carcass weight obtained. The second scenario is when contract producers are linked to input suppliers for supplying them with bulk inputs at a

discounted price. The large-scale commercial producer guarantees the contract producer with input supplies. The contract producer then incurs the other management cost, slaughtering costs and transport cost delivering dressed whole birds at an agreed price.

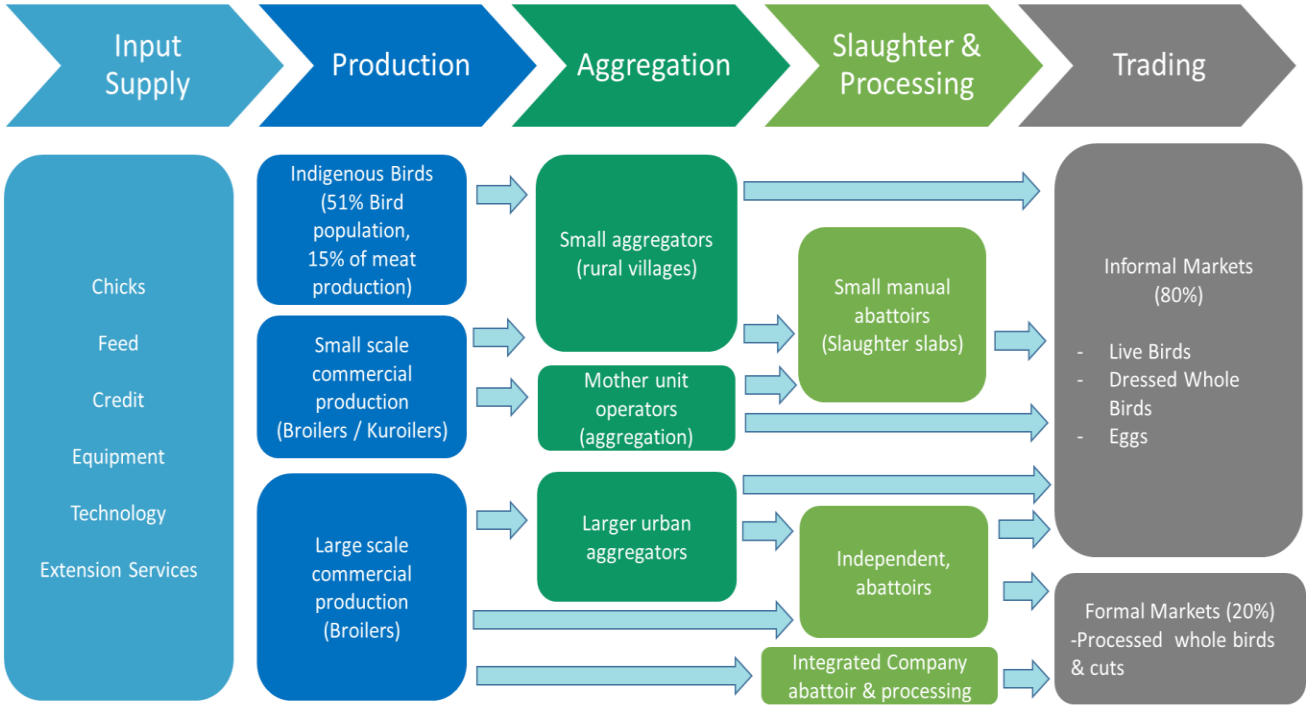


FIGURE 10: VALUE CHAIN MAP OF THE "AS IS" POULTRY VALUE CHAIN STRUCTURE

The value chain structure shows that the input supply system for poultry farming is largely dependent on the supply of DOCs, feeds and medications including vaccines (Figure 10). The other potential inputs availed through the existing input supply system are research and development, equipment, charcoal, extension services, water, electricity, labour, market information and financial services. The supply of DOCs requires well-established breeding and hatching systems. Tanzania is currently importing the parent stock. The breeding and hatching system is characterized by limited number of breeder farms (exotic breeds and indigenous breeds), Lack of parent stock farms and relatively high price for imported parent stock. However, there is a growing number of investors interested in establishing breeding farms and hatcheries.

The hatching system is not well developed and operating under its capacity due to shortage of fertilized eggs. The study established that many hatcheries and incubators are running 30% below their capacity. The system seems not well structured and weak in linking breeders involved in hatcheries with suppliers of fertilized eggs. Commercial hatcheries exist but experience fluctuations in the level of supply of DOCs due to dynamics experienced in getting the parent stock and fertilized eggs. Some of the commercial hatcheries that exist in

Tanzania are Interchick Limited, Mkuza chicks, Discount Incubator Tanzania, AKM glitters Company Limited, Msigani poultry breeding farms and Silverlands Tanzania Limited.

Feed is another key input into the poultry production system. Feed manufacturers grind and mix chicken feed from locally available feed materials. Tanzania feed has high proportional of maize (60%). The other formulation includes 20% soya mainly sourced from Zambia and Malawi; 7% is sunflower cake; 3-5% is fishmeal and the remaining proportion is other additives. Three key categories of feed manufacturers exist. These are commercial large scale feed manufacturers such as Silverlands Tanzania Limited and Interchick Limited, medium scale such as Tanfeed Limited and small scale feed manufacturers. Small scale feed manufacturers use simple grinder and mixer. The government through the ministry of livestock and fisheries regulates all feed manufacturers. This is done to ensure that there is correct formulation of all the ingredients required in poultry feed. It was noted that the Tanzania feed industry faces some significant challenges. These include high costs of feeds driven by high prices of maize in many years. The price of maize is contributed by low yields, transportation costs from maize surplus regions to feed manufacturing regions (Dar es Salaam, Iringa and Morogoro) and the competition for white maize between feed and food. Tanzania does not widely produce yellow maize that are suitable for feeds. Low production of soybean is another challenge leading to high dependence on soybean imports. There is protection of the feed industry in Tanzania through removal of VAT on domestically manufactured feeds. However, some other taxes such as a charge on movement of animal feeds and livestock resources still exist. Feed manufacturers and traders are charged $2.3 per tonne when crossing districts in the country. Exportation to nearby countries including transfer to Zanzibar is charged at $22.3 per tonne. This tax is also charged for transportation of chicks at $ 0.45 per 100 chick container.

Medications and vaccinations is an integral part of a good poultry management program. Diseases such as Newcastle disease, fowl pox, Gumbolo disease, avian influenza, salmonellosis, coccidiosis, fowl typhoid, Avian Malaria, ticks and round worms are caused by infectious like virus, bacteria, parasites and fungus, and normally seem to be a huge problem attacking poultry sector at large. Vaccines are given at a certain interval mostly after every three months however, it should not be suitable for bio-security and sanitation because vaccination may not totally protect birds that are under stress or in unhygienic condition. The primary objective of vaccinating a flock is to reduce the level of clinical diseases and to promote optimal performance. This is the reason for many flocks to be vaccinated multiple times for the same disease to maximize the immune system's response. Layers require more vaccines since they remain in production for longer (usually about 18 months) compared to broilers that are for body growth and weight. Availability of medications, vaccines and vitamins is not a problem due to proper regulation and high involvement of the private sector. Costs for vitamins are $4.5/kg while vaccines are sold at $3.6-4.5/litre. The Tanzania Livestock Veterinary Laboratory Agency (TLVA) based in Dar Es Salaam is the regulator in this key poultry input. TLVA also produces vaccine against new castle costing $0.02/vaccination/bird. Other vaccines and medications are available through the private sector. It was noted further that the

importation of veterinary drugs and vaccines has been left to the private sector. This has increased access and availability of veterinary services to farmers within the poultry value chain.

Chicken cage, egg collecting, drinking and feeding systems, manure removing system, slaughtering tools and feather removal are important equipment in the poultry production system. In Tanzania, small and medium commercial farmers use manual feeder and drinking systems. Automated feeding and drinking lines are only used by large commercial poultry producers due to high capital requirements of the systems. Likewise, few large commercial poultry producers in the country own the slaughtering and feather removal machines. Inefficiencies in both the production and value addition processes are notable due to difficulties experienced in accessing the mechanized equipment. Value chain financing is key to ensure that these capital-intensive equipment and technologies are accessible by producers in the poultry chain. Availability and access to these technologies will increase efficiency and labour serving in addition to fostering quality and standards.

Research, training and development is an integral part of the poultry production system. The Tanzania Livestock Research Institute (TALIRI) coordinates research as an important aspect through its network of research centers in the country. These centers are located in Mbeya, Iringa, Tanga, Dodoma, Mwanza and Mtwara. Universities such as Sokoine University of Agriculture (SUA) also play an important role in poultry research. Further training is mainly offered by public extension services that have limited capacity and only a few private sector veterinary consultants could be located with this study. Informal payments are made in case a producer calls a veterinary officer. The cost is mainly for transport and medications. The coordination of extension services seems to be a challenge with both the Ministry of Livestock and Fisheries and the Ministry of Regional Administration and Local Government Authorities who are responsible for public extension service.

Commercial poultry farming is an emerging activity in Tanzania. Thus, there is limited knowledge, skills and experience in the public domain making the availability of skilled labour to manage poultry farms a challenge. Many poultry producers use family labour. Some of the input suppliers fill this gap through training of producers during the purchase of inputs. Interchick Tanzania and Silverlands Tanzania are some of the input suppliers who have free weekly courses they offer to producers who buy inputs from them.

Other key inputs are financial services, market information, source of power and heat (charcoal and electricity) and water. The majority of value chain actors, especially in the informal value chains underlined the challenges of access to affordable credit due to collateral requirements and formalization of their financial accounting systems. As already discussed in the previous section, market information systems in the poultry chain are not formalized and there are significant gaps in critical market information. It was reported further that, the cost of power is high and not stable affecting mostly the hatcheries.

Aggregation is done through agents/aggregators. There are rural (village) and urban-based aggregators. Aggregators mainly buy from producers by picking up on farm and selling in specified markets as live bird or slaughtered. Farmers rarely deliver directly to consumers. A high amount (80%) of aggregated poultry products are traded through the informal markets as live birds, dressed whole birds and eggs. The other amount (20%) goes through processing. These processed products are traded in the formal markets. There is a preference of producers to deliver their products through agents/aggregators. This is because the payment terms of processors and traders in the formal markets are too long.

Processing/value addition is hampered by shortage of processing facilities and poultry value addition technologies. There are small manual abattoirs (slaughter slabs), independent abattoirs, and integrated company abattoirs and processing units that add value in poultry industry. Small manual abattoirs (slaughter slabs) are done manually; independent abattoirs and integrated companies operate both manually and with machinery. Independent abattoirs serve as service providers charging slaughtering cost in the region of $0.22/bird. In most cases the processing through slaughtering in the informal markets is done with very basic tools near a market place or farm base area. Integrated company abattoirs like Interchick Limited and processing lines such as Matuli farm slaughter their own birds as well as contract growers. Processors sell generic chicken in pieces, dressed whole, prime cuts and dressed cut up. The average price of broiler chicken meat is $2.7-3.2/kg. For processed chicken products like sausages, there are only a few processors that exist, which are mainly linked to large-scale commercial production units like Bahari Bounty/Kuku poa based in Mwanza, Interchick based in Dar es Salaam, Matuli Farm based in Morogoro and Happy Sausage; based in Arusha and Moshi.

Trading of poultry products is largely done through the informal market (80%). The poultry products traded through the informal markets includes live birds, dressed whole birds and eggs. The other products (dressed cut up; prime cuts; pieces; eggs, sausage and chicken fillets) are mostly traded through the formal market which makes 20% of the total volume traded. Producers due to credit policy of large companies/institutional buyers prefer informal markets. Example; catering service providers for large mining companies usually pay on 90 days after delivery. Supermarkets pay after 30-60days. This payment method is not good especially to small-scale producers who require payments to restock. Products traded from the indigenous flock is low (10%). The remaining (90%) is retained for home consumption.

There are various categories of buyers both in the formal and informal markets. High profile hotels normally prefer exotic breeds, as their supply is more reliable and less costly. The local hotels and restaurants including bars and pubs buy exotic and local chicken depending on their clients. However, supply reliability and high costs of local chicken makes them prefer exotic breeds. Institutional buyers prefer exotic breeds. Households in the rural areas prefer local chicken while those in urban areas prefer for exotic breeds due to their availability and relatively low

cost. Exotic breeds are also normally well dressed, packaged, and sold in urban supermarkets. Local chicken meat is not common in supermarkets. Vertically integrated growers are also key buyers of chicken for their slaughtering or processing facilities. The consumption of poultry meat in Tanzania is generally low (per capita consumption is approximately 2kg) influenced by low per capita income.

3.2 Product flow per value chain

For the purpose of this study, the Tanzanian poultry industry was categorised into three distinct value chains, namely traditional household chicken production with indigenous and improved birds (VC1a & VC1b), commercial chicken production with indigenous and improved birds (VC2a & Vc2b) and contract commercial large-scale chicken production with broilers (VC3).

Indigenous local production system (Figure 11) involves keeping chickens in a free-range system with supplemental feeding mainly from household rests, maize, rice and wheat bran. This system is operated by 80% of the rural households. Households keep an average of 5 to 40 birds in a free-range self-sustaining cycle where they do not normally buy in new DOC/birds. This system is dual where households produce both meat and eggs. The mortality rate is high (40% to 75%) with very poor productivity. One bird raised under this system reaches 1-1.5kg live weight maximum after 1 year and this type of chicken can live up to 6 years. They have three lying cycles with approximately 12 eggs per cycle per annum. A large portion (90%) of poultry products under this system is retained for home consumption and restocking. Restocking is done using own eggs with hatchability of approximately 60%. Only 10% of the flock is marketed and goes through aggregators/traders for marketing where, eggs and live birds are sold and whole birds dressed sold after being processed in slaughtered slabs.

Unlike the Indigenous local production system, the improved production system (VC1b) involves the breeding system of breeder, hatchery and brooder. This is the new type of production system and value chain that is proposed by the ACGG initiative where improved birds are used in the traditional household production system and there are currently only a few of these systems in Tanzania. Breeders typically own one to a maximum of six hatcheries all of them placed at backyards. Their hatching capacity ranges from 50 to 1000 eggs per month. Some hatching equipment is manufactured locally. They provide hatching service but also hatch for their own farm. The hatching cost is $4.5 per tray of 30 eggs. Hatching rate is 50% to 83%. Breeders accept eggs from hybrid *(chotara)* and indigenous chicken. They also provide advice on how to select best eggs for hatching.

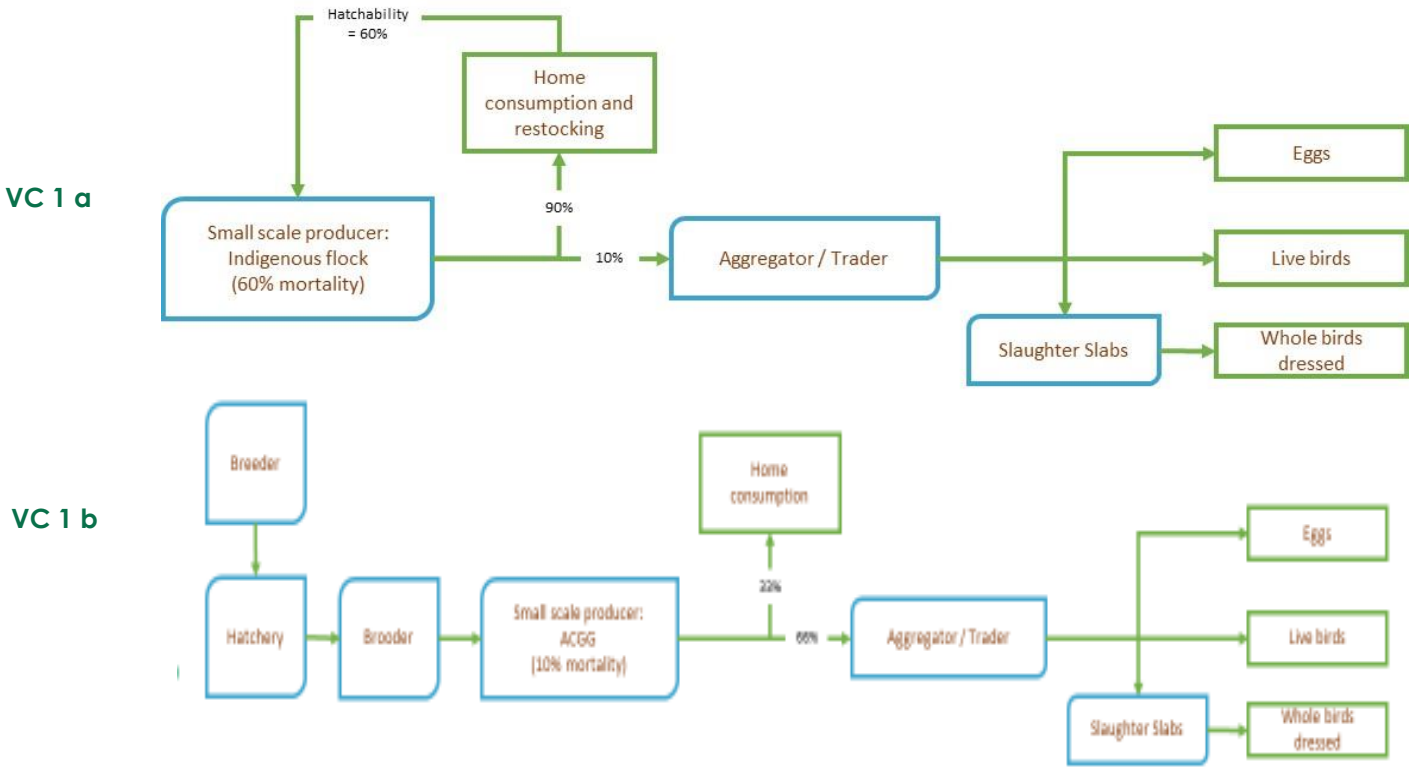


FIGURE 11: TRADITIONAL HOUSEHOLD CHICKEN VALUE CHAIN (VC 1A & VC 1B)

Production is done under small-scale integrated with pure genetics from Kuroiler or Sasso with approximately 500 birds. These are dual birds for eggs, meat, and reaches 1-1.5kg live weight maximum after 6 months and can lay 75 eggs per annum. Chicks' mortality rate is approximately 15%. They are free range, searching food at their own and small quantity of feed bought. Male birds have to be sold to market or used for own household consumption before 6 months since breeding will then start and own household reproduction not desirable due to the risk of cross-breeding with traditional chickens. Furthermore, since these are hybrid birds, own household reproduction will negatively affect long-term performance of the breed. There is significantly higher productivity but at increased costs due to the purchase of DOC, supplemental feed and other inputs. Breeders usually sell 400g old bird after 4 weeks at approximately $2/bird. There is some capital investment into this production system leading to 66% of the product being marketed. The main clients are small households that are currently only producing and consuming traditional chickens. Aggregation is typically done by traders on motorcycles with baskets on the back that buy small volumes (4-10 chickens) from households that are selling surplus chickens. Products sold are eggs and live birds. Value addition is done in local slaughtering slabs with manual equipment.

The commercial indigenous production system with traditional birds (VC 2a) involves commercial small-scale producers with traditional breeds of average 200-300 chickens. The scavenging system is not possible anymore due to lack of space. Therefore, it involves more intensive feeding operation. Producers buys DOC from hatchery at 0.7-0.8$ per chick. They sometimes take own eggs for hatching service a cost of 4.5$ per tray of 30 eggs. The productivity of birds is generally low and produce both meat and eggs. Producers sells mainly eggs and live bird to aggregators in the informal markets (80%) of rural and urban areas and some used for own household consumption. Aggregators aggregates typically at the market in bigger consignments of approximately 200 birds and delivers to hotels and bigger towns. However, aggregation of eggs is rarely done.

Similar to the VC 1 production system, there are also small-scale commercial production system that make use of the improved pure genetics like Kuroiler and Sasso (Figure 12) and are therefore linked to integrated hatchery and breeder companies. These companies import eggs as parent stock; majority is Kuroiler from India, and Sasso from France. Others import from Uganda and Malawi. They own hatcheries with hatching capacity from 1000 to 30,000 eggs. Two companies (Silverland and AKM Gliters) are integrated from feed mill to parent stock production and venture into contracting with mother units. These companies so far have established more than 600 units around the country, Lindi being the leading region. Others are Dar es Salaam, Coast, Dodoma, Iringa and Mbeya. Other companies are Tanzania poultry farm in Arusha, Mkuza and Organia chicks in Kibaha, Kibo Poultry in Moshi, Amadori farm in Kerege-Bagamoyo, Kuku Poa in Mwanza, Interchick in Dar Es Salaam and central chicks in Dar Es Salaam. Hatching is usually done in incubators whereby 60% is successfully hatch and goes to small scale commercial producers while 40% goes to mother units (brooder) that grow poultry. Production in mother units is uncommon and happens only if all chicks not sold prior to restocking. Productivity is high due to improved genetics, yet intensive production systems also demand a higher use of inputs; DOCs, feeds, medicines and vaccines. Poultry products produced (live bird, whole bird dressed and eggs) are sold to aggregators and aggregators mainly sell to consumers in the informal markets. Value addition is usually done in manual slaughter slabs that lack plucking machines/equipment. This challenges the hygiene and quality of the product.

The last category of value chains is found with commercial and contracted production systems (VC3) that involve medium or large-scale commercial poultry producers. Many are in broiler meat production with very high productivity and feed conversion ratios. They are involved in contract/agreements with parent stock companies. The parent stock companies import DOC from Holland at an average ratio of one male to four female. Importation is done after every 3 months. The mortality rate is 3% at rearing and 2% at production. The length of rearing cycle is 24 weeks and the total cycle is 64 weeks. The feeding during rearing is 130gm/day for 24 weeks; laying 3.9kg /day from 24 to 64 weeks. Males are fed more on seedcake while females are fed on cotton cake. The hatching rate is mostly 100% as it is very rare to get a loss. Sometimes a loss of 10% (i.e. max 3 eggs per tray of 30) can be experienced. The capacity of production of these parent stock companies is 50,000 to 150,000 DOC per day. They vaccinate DOC for Mearx and Newcastle before selling.

Parent stock companies sell to their contract growers and others and buy back live birds from contract growers only. Contract growers produce for them and sell to other markets. The terms of the contract that growers have with these large companies focus on mortality rate, feeding regime/FCR, live weight of 1.6 to 1.7kg per bird and quality (i.e. absence of bruises or broken bones). The latter is determined after slaughtering which means the contracted producer is paid once the birds are slaughtered and checked. This is done in the presence of both the contractor (operations manager) and the contract grower. The integrated company does the processing and the costs are deducted from the contract grower's revenue. Integrated companies have modern equipment for slaughtering. In situations where contract growers have surpluses above what is contracted, they sell live birds or whole dressed birds after being slaughtered into the informal markets. Integrated companies always supply their products into the formal markets (formal retail, hospitality, supermarkets, restaurants and catering, institutional) as a whole bird dressed.

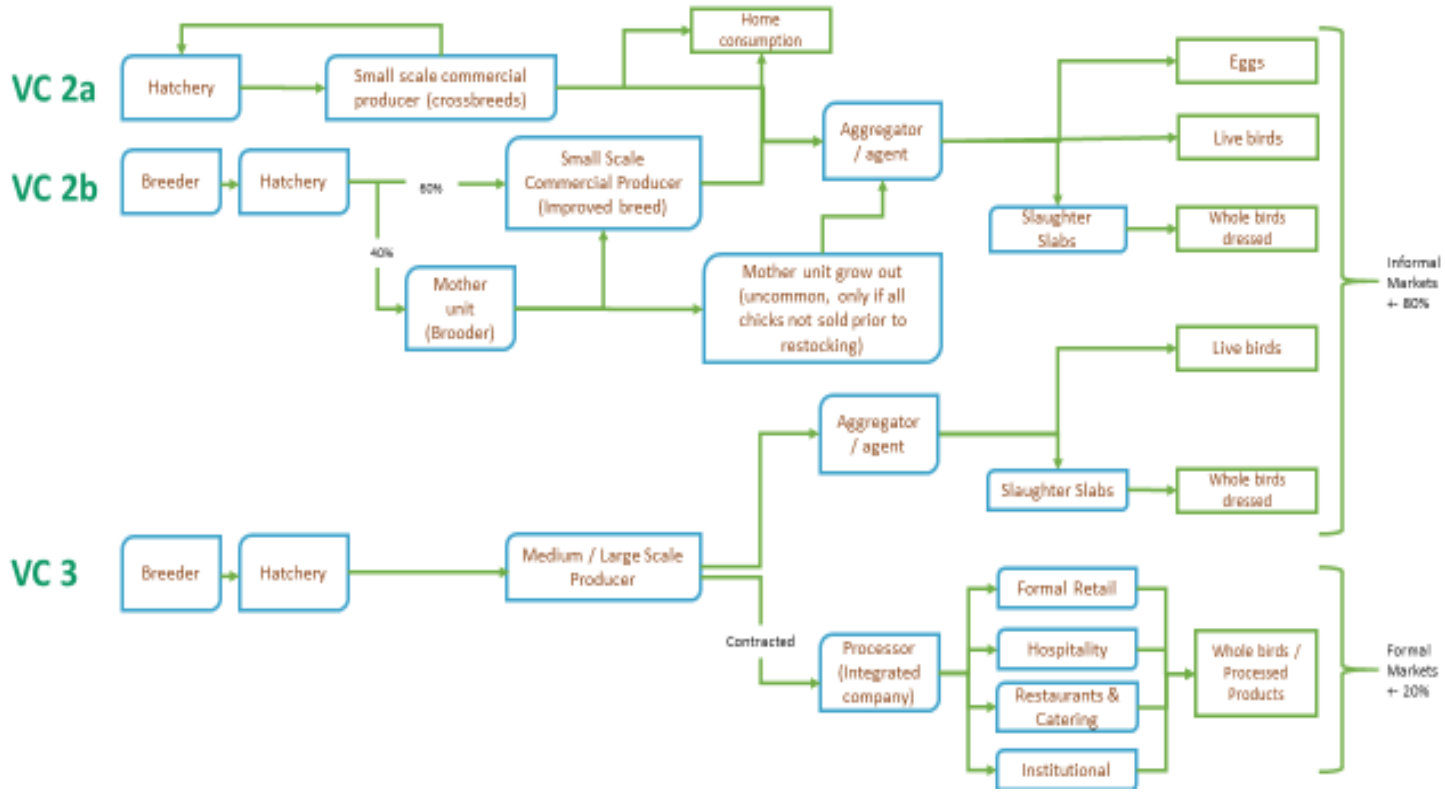


FIGURE 12: COMMERCIAL SMALL SCALE AND LARGE SCALE CHICKEN PRODUCTION VALUE CHAINS (VC 2A & VC 2B, VC3)

3.2 Gross margin analysis

Based on the presentation of the value chains within the three main production systems, this section presents and detailed analysis of the gross margins at each node in the various value chains. The calculations are mainly based on primary data that was collected in country by the research team. For some of the technical productivity factors like the productivity of the improved birds, published literature on official trails was used. Apart from highlighting the relative margins, the purpose for this calculation is to evaluate the relative competitiveness of the chains by comparing the direct costs of producing one unit and the product selling price at each node in the chain to import parity versus commercial large (VC3) versus commercial small (VC 2a&b) versus traditional household production (VC1 a&b). In doing this, the relative competitiveness of the introduction of improved genetics form birds like the Kuroiler and Sasso is assessed from a gross margin perspective. The comparison of gross margins in itself will not be sufficient to make a final judgement on the potential uptake and sustainability of these improved dual purpose breeds in Tanzania. Apart from the shift in tastes and preferences, especially amongst the younger urban population that is shifting towards more broiler meat consumption, part of the answer also lies in the potential evolution of the feed industry. The feed industry will be discussed in more detail in the following section.

Figure 13 presents the estimated cost of production and income earned per bird placed, as well as gross margins for breeders of improved dual purpose breeds (VC 1b and VC 2b), relative to large scale broiler breeding operations (VC 3). The breeding operations include both the rearing of parent stock and the production of fertile eggs for hatching once the parent stock has been reared to point of lay. Rearing and production operations are typically undertaken by the same enterprise, hence only one margin is calculated for the entire operation.

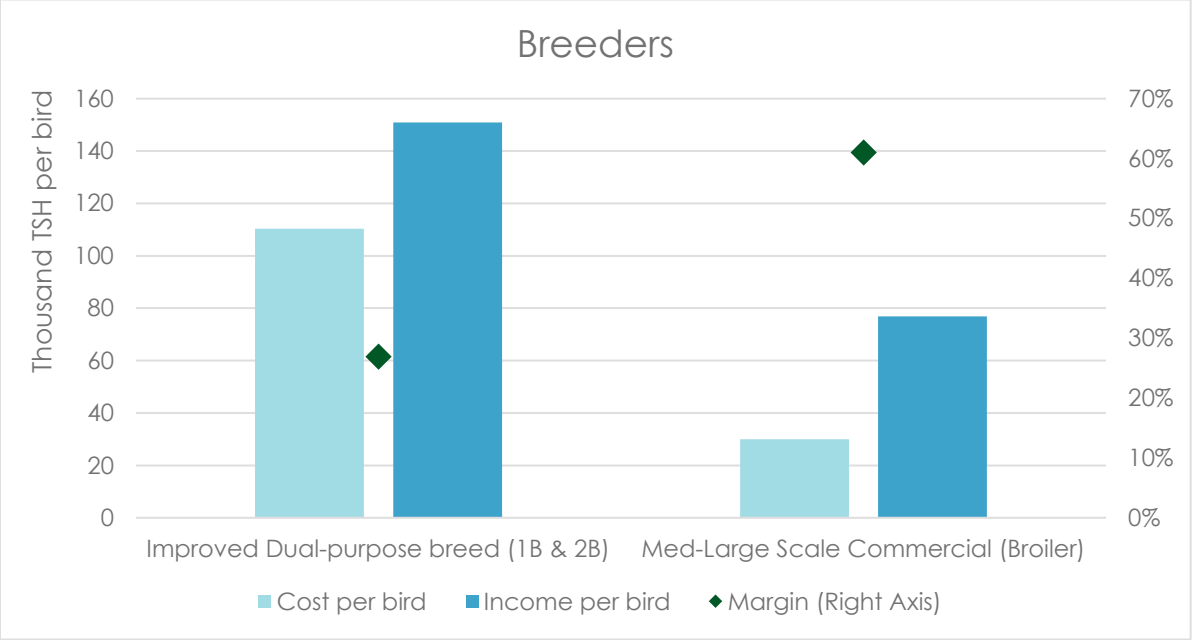


FIGURE 13: COST, INCOME AND MARGINS FOR BREEDERS IN DIFFERENT VALUE CHAINS

For the improved dual purpose breeds, both the cost of production and income earned per bird are larger, due to the fact that the laying cycle of 450 days is significantly longer than that of the broiler breeder, which was only 280 days. The absolute margin per bird placed in the improved dual purpose breeds was estimated at 40.6

thousand Tanzanian Shillings, or 27% of the revenue earned per bird. In the broiler breeding operation, the absolute margin per bird was estimated at 47 thousand Tanzanian Shillings, which equates to 61% of revenue. Broiler breeder operations typically also operate at a larger scale that improved dual purpose operations.

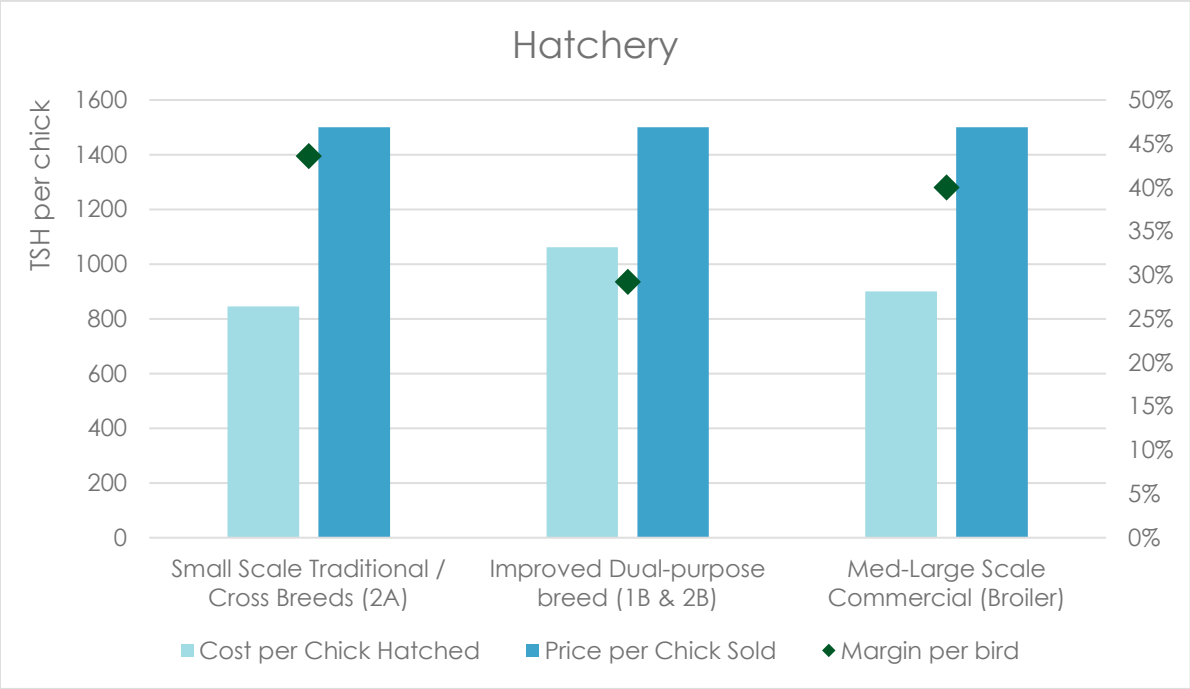


FIGURE 14: COST, INCOME AND MARGINS FOR HATCHERIES IN DIFFERENT VALUE CHAINS

Figure 14 presents the estimated cost of production, as well as revenue per chick and gross margin calculations for different value chains at hatchery level. Value chain 1 and 2 are small scale hatcheries utilising both traditional indigenous, crossbreed or improved dual purpose breeds, whereas value chain 3 is much larger in scale, hatching only commercial broilers. Hatcheries utilising traditional indigenous or cross breeds typically operate independently and can either buy in eggs from producers to hatch and sell as day old chicks, or hatch eggs for producers at a pre-determined hatching fee. The small scale indigenous or cross breed hatchery reflected in Figure 14 (VC 1A or VC 2A) is represented as units that buy in fertilised eggs for hatching. The improved dual purpose breed hatchery is often integrated as part of a breeder farm, but reflects only the costs of the hatching process, with the cost of fertilised eggs set at market value. By contrast, the broiler hatchery operates at a much larger scale and are almost always integrated with parent stock operations. Costs are indicative of those associated with the hatching process.

While the price of day old chicks was similar across most of the hatcheries represented, the cost structure and scale of operation differed significantly. In VC 2A, the hatchery is small, with a capacity to hatch 2000 eggs per week, but a current utilisation rate of only 1000 eggs per week. Consistent supply of fertile eggs for hatching was raised as a challenge to this system, as poor laying productivity implies that specialised parent stock operations for traditional indigenous birds are rare. Fertilised eggs are typically procured from customers that have bought and raised chicks. Hatchability is typically low at approximately 63%, but running costs are also fairly low and fertile eggs relatively inexpensive, resulting in a good margin of 44%. In the event that eggs are brought in and hatched a fee, the hatchability risk is with the producer and not the hatchery.

In VC 1B and 2B, the scale of operation is larger, with current production of approximately 9400 per week. The cost of fertilised eggs is higher, as a premium is paid for the pure genetics and consequently the total cost of

production is also increased relative to the VC 2A hatchery. Hatchability levels are however also improved at 83% and the estimated 29% margin attained is still favourable.

In VC3, the commercial broiler hatchery is typically much larger, and the unit reflected in Figure 14 has a capacity to hatch 210 thousand chicks per week. Fertilised eggs are typically produced by an integrated parent stock operation and are therefore the lowest of the three types of hatcheries surveyed. While the estimates point to a solid gross margin of 40% of revenue earned per chick, current utilisation rates were reported at only 70%, due to limited parent stock operations.

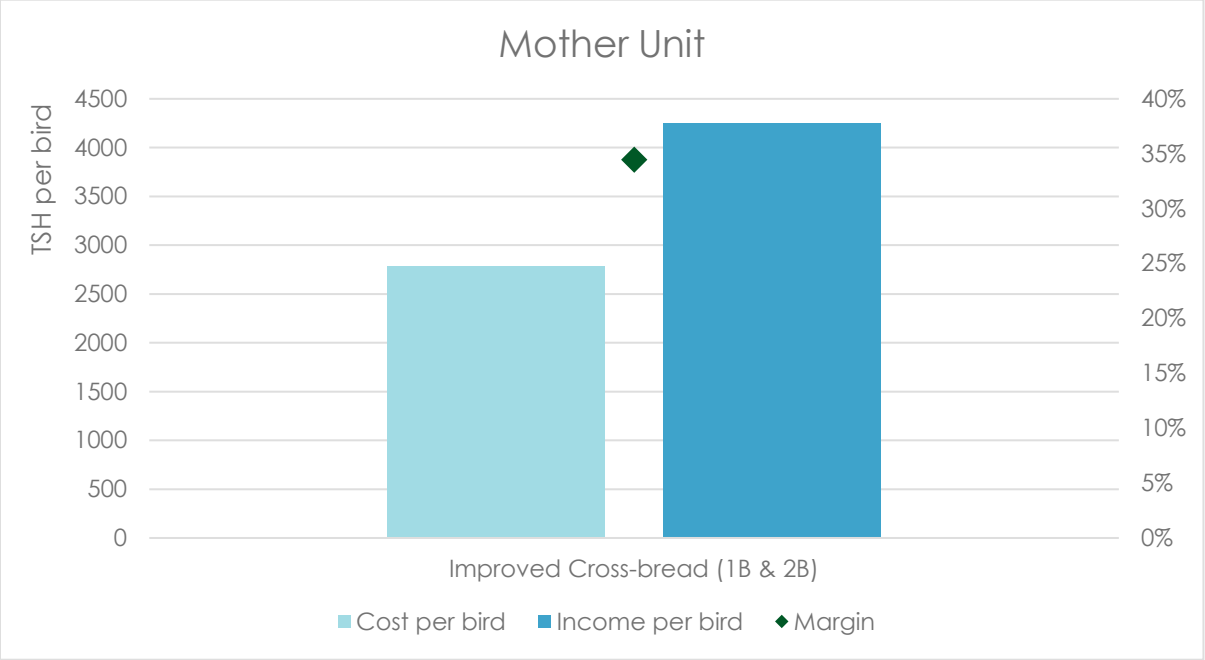


FIGURE 15: COST, INCOME AND MARGINS FOR MOTHER UNITS (BROODERS)

Figure 15 presents the estimated production costs, income generated and gross margins attained for mother unit operations, which were only found in the improved dual purpose breed value chains (VC 1B and VC 2B). The purpose of the mother unit is to ensure a proper feeding and vaccination programme for these breeds over the first 2-4 weeks. Across the different operations surveyed, average scale was 450 birds per cycle. Feed and Day old chick procurement represented the largest cost components and margins were estimated at approximately 34% of total revenue. The price obtained differed across producers and over time, as older birds are typically sold at a higher price.

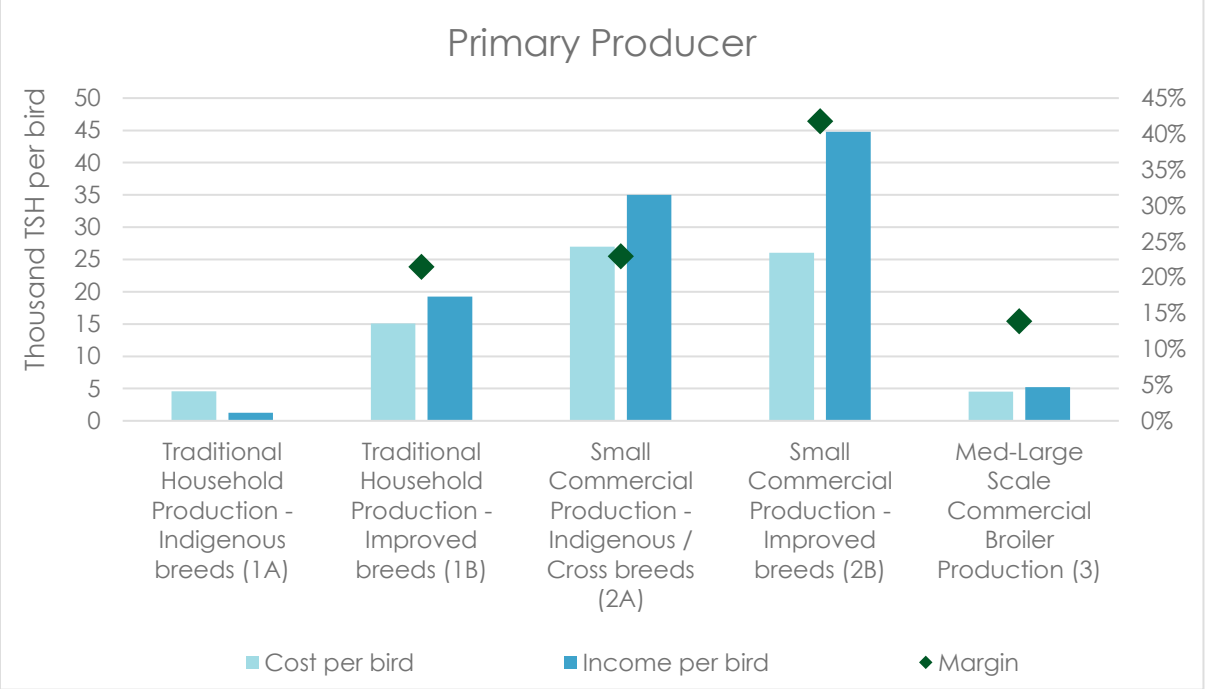


FIGURE16: COST, INCOME AND MARGINS FOR PRIMARY PRODUCERS IN DIFFERENT VALUE CHAINS

Figure 16 presents the estimated production cost, income generated and gross margins attained by primary producers in the various value chains. VC 1 relates to a traditional household production system, with a typical size of approximately 20 birds. In VC 1A, these birds are traditional indigenous breeds, while VC 2 operates at the same scale, but with improved dual purpose breed genetics. The scale of operations compares well with the average number of 15 birds per household reported in the National Panel Survey of 2014/15 (NBS, 2016). Producers are assumed to market only approximately 10% of total production, with the rest allocated to own household consumption, as well as hatching for flock regeneration.

VC 2 is a more commercially inclined and larger scale producer, typically keeping approximately 200 birds per cycle. This compares well with the larger scale operations reported in the National Panel Survey of 2014/15 (NBS, 2016). Whilst more commercially inclined, the same number of birds and eggs consumed in VC 1 are still allocated to household consumption in VC 2. The value of this consumption is however increased slightly, as birds are larger and consequently more expensive (Figure 17). VC 3 represents large scale, fully commercial boiler operations with no household consumption and approximately 50 000 birds per cycle.

In Figure 16, the margins calculated for VC 1A are negative, due to both poor productivity, with each bird producing only 36 eggs per year, and the fact that only 10% of production per cycle is assumed to be marketed. This estimate is based on industry estimates, and implies that 12 chickens and 207 eggs are retained for consumption per annum. In terms of chicken consumption, this aligns well with Queenan *et al*. (2018), who also noted that approximately 12 chickens were consumed per annum by small scale producers in Tanzania. At a typical live carcass weight of 1.2kg, a carcass yield of 70%, and a household size of 5, this yields per capita consumption of just over 2kg per year – very close to the national average. In terms of eggs, the number is higher than the 60 estimated by Queenan *et al.* (2018), but in a typical household of 5 to 6 people, still remains well below the per capita egg consumption in Tanzania of 106 eggs per person per year estimated by Kaijage (2015). It is expected that household consumption in rural areas will be well below the national average, due to greater affluence in the cities and high egg volumes consumed by tourists in hotels. In a household of 5 people, the assumed consumption of 207 eggs per year implies 41 eggs per person per annum.

Within this traditional household production system, costs are predominantly associated with supplementary feeding, as there is no procurement of day old chicks and some of the eggs are simply retained and hatched for flock regeneration. Mortality was high, in excess of 50% and the hatchability of eggs retained for hatching also only 50%. Of total eggs produced, 22% were retained for hatching, 70% consumed and 8% marketed. While margins were negative, consideration of the value of 12 birds and 207 eggs consumed per year implies that the net position (financial and value of consumption) is positive. Figure 17 illustrates that from a 20 bird unit, the value of own consumption, as well as income generated from sales provides a net positive of just over 100 thousand Tanzanian Shillings per annum.

When the same flock size is replaced with improved dual purpose breeds, productivity is improved to the extent that, with the same number of chicken and eggs consumed per year, producers are able to sell 319 eggs per cycle, a 9 fold increase from the 35 eggs marketed from traditional breeds. Furthermore, birds grow quicker and ales can be slaughtered at an earlier age, enable 2 rearing cycles per year and increasing the number of chickens sold per annum to 10, from merely 2 in the indigenous value chain. Consequently, despite incurring a cost for chicks, producers are able to realise a margin of 21% (Figure 16), doubling their net position after accounting for own consumption (Figure 18).

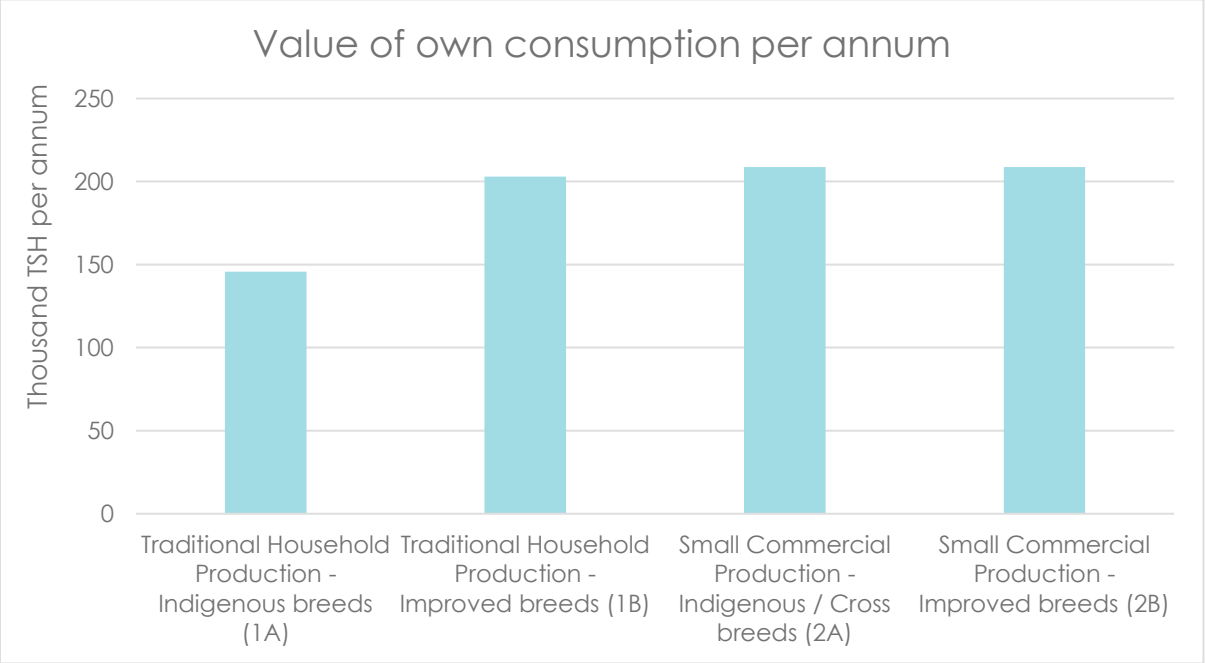


FIGURE 17: VALUE OF OWN CONSUMPTION PER ANNUM IN DIFFERENT VALUE CHAINS

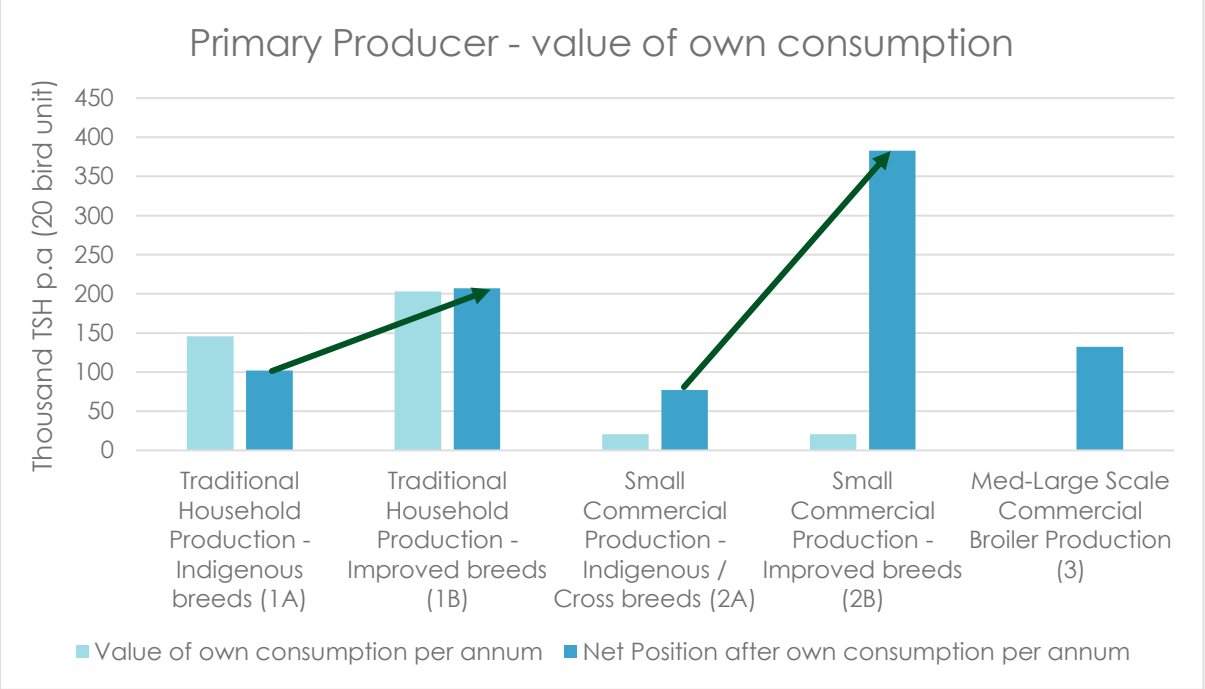


FIGURE 18: VALUE OF OWN CONSUMPTION AND NET POSITION FOR DIFFERENT PRODUCERS ON A 20 BIRD UNIT

In VC 2, annual consumption was retained at the levels of VC 1, but the larger scale of operation and more commercial inclination implies that a significantly larger share of the birds are marketed, yielding a margin of 23% from crossbreeds (VC 2A). This is further improved to 42% if producers introduce pure, improved dual purpose genetics (Figure 16). **It is worth noting that the largest cost contributor in this value chain is feed and producers indicated that, at current cost levels, they are unable to generate a profit when feeding at levels suggested by feed manufacturer guidelines.** This was confirmed by alternative gross margin calculation - at the higher recommended feeding levels, the cost of production in VC 2A and VC 2B increase to 48 500 and 54 300 Tanzanian shillings respectively, significantly more than the income generated. Consequently, producers tend to feed significantly less, instead utilising the birds scavenging ability. Some producers were also found to mix commercial rations with maize bran, thereby reducing the total cost of feed, but naturally also affecting the quality.

Evaluation of commercial broiler margins in Figure 16 are indicative of a much lower cost of production, as well as a significantly lower income per bird. The first reason for this is the differences in production cycle, broilers are produced purely for meat and are fed in a 28 to 35 day cycle, whereas dual purpose breeds are raised for approximately 5 months, before starting a 390 day laying cycle. The short feeding period also provides optimal feed conversion ratios. Income is only generated by meat sales, whereas dual purpose birds provide an initial income from egg sales, before additional revenue is gained from depopulation at the end of the cycle. Despite the lower levels of both costs and revenue, broiler producers still attained a margin of 14%, with the scale of operation implying a much larger income per annum relative to the 200 bird dual purpose units of VC 2.

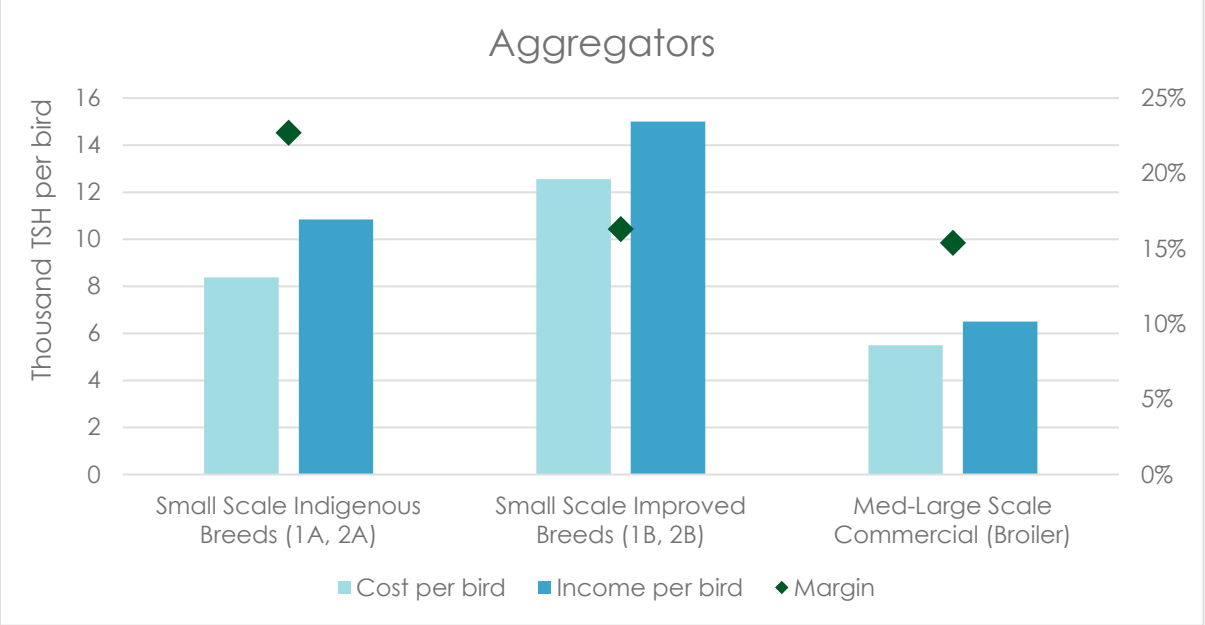


FIGURE 19: COST, INCOME AND MARGINS FOR AGGREGATORS IN DIFFERENT VALUE CHAINS

Figure 19 presents the estimated production cost, income generated and gross margins of aggregators dealing in small scale indigenous birds (VC 1A and VC 2A), small scale improved dual purpose breeds (VC 1B and VC 2B) as well as larger commercial broiler operations. In reality, small aggregators in rural areas would sell both indigenous and improved dual purpose breeds such as SASSO or Kuroiler, but the margins are indicative of the value attained from the different birds. The cost structure of the aggregators is fairly simple, with transport, as well as repairs and maintenance being the primary components. Some have a small feeding component if all birds are not sold immediately. There was significant variation on prices both for birds bought and sold, as heavier birds are typically more expensive. Indigenous birds were however consistently cheaper to procure than improved breeds, due to the smaller carcass. The margins attained on indigenous and improved crossbreeds were similar in absolute value, but expressed as a percentage of revenue, aggregators attained approximately 23% on indigenous breeds and 16% on improved breeds. It was noted however that improved breeds are typically always all sold, which is not necessarily the case for the indigenous breeds. On commercial broilers, both the cost of purchase and sales price is lower, but a 15% margin was still achieved.

FIGURE 20: COST, INCOME AND MARGINS FOR SLAUGHTER AND PROCESSING UNITS IN DIFFERENT VALUE CHAINS

Figure 20 presents the estimated costs, income and margins for slaughter and processing for both small manual operators utilising slaughter slabs and a larger, semi-automated abattoir. Whilst the cost of the bird is included in the small manual slaughter figure, to provide an indication of the share of revenue in the end product, the reality is that such operators don't typically buy the birds. Instead, they provide a slaughtering service at a fee, typically 500 Tanzanian Shillings for slaughter or 1000 Tanzanian Shillings for slaughter and packaging. Costs are limited, associated mainly with sanitation, as the manual slaughter process only requires compensation for own labour. Even in the semi-automated facility did not have a high cost structure per bird, but only realised a small margin of 5%. This facility currently processed 8000 chickens per day.

3.3 Input supplies – the feed industry in Tanzania

In Tanzania the poultry feed sector is still developing with a steady annual growth in both the commercial and traditional sub-sectors. Poultry production is an important source of protein both in the form of poultry meat and eggs. Strengthened technical support that encourages the use of appropriate modern technology in poultry production requires that the quantity and quality of poultry feed supports this objective. The formation of industry organisations such as Tanzanian Animal Feed Manufacturers Association (TAFMA) is an encouraging sign of how the formal industry has developed. National standard for feed quality contributes to the integrity of the industry.

3.3.1 Feed quantity

The low consumption of livestock products in Tanzania has resulted in the low demand for animal feeds. According to Lekule (2018) the growth of the poultry industry and hence poultry feed is influenced mainly by the availability of day old chicks and the availability of soya. The investments that are in the process of being made by Tyson/Irvines will change the situation regarding availability of commercial chicks to reduce the reliance on imported fertile eggs. Tanzania has no grandparent farms and is thus a net importer of parent stock for both

broilers and layers. Investment in poultry breeder farms and hatcheries will improve the availability of day-old chicks.

The current investment by Tyson Foods and Irvines (PoultryWorld 2018) will potentially make Tanzania the fourth largest poultry producer in Africa and halt its and neighbouring countries dependence on imported poultry from Brazil and the United States. The investment has taken place in the Kilimanjaro district. The new investment will commence with 250 000 *Cobb 500* (name of breed) parent broilers per week which will supply between 500 000 broilers building up to 2 million-day old broilers a month enough to feed all Tanzania's commercial poultry consumers. The commercial sector until now was small. Reliable supply of day old chicks will be a major change in the Tanzanian poultry industry. Personal communication with Irvines indicates they are expecting similar performances that are being achieved in their operations in various countries which is equivalent to the Cobb Standards. Irvine's information was also published in the Citizen where it was mentioned that the 2 million-day old broilers facility appears to be ramped up in phase 2 of the project (fttps://www.thecitizen.co.tz/News/Sh32-billion-poultry-project-in-the-offing/1840340-4255152-9rr287/index.html). Estimated at 43 200 tons, it is anticipated that this new production of broilers will satisfy commercial chicken consumption in formalised markets but not the traditional chicken consumption. As previously mentioned, Tanzania's total consumption is estimated around 100 000 tons. There are no reliable figures available for commercial feed production quantities and there is an urgent need for that. Table 3 presents the feed quantities in Tanzania estimated by SAFMA (2018).

TABLE 3: MARKET SIZE VOLUME (TONS)- FORMAL AND INFORMAL MARKET (TONS PER ANNUM)

	2016 (Tons)	2017 (Tons)
Dairy	6 000	7 000
Beef Sheep & Goat	24 000	26 000
Layers	195 000	150 000
Broilers	455 000	380 000
Total	**680 000**	**563 000**

3.3.2 Feed quality

Feed quality is a major factor when discussing feed measured in terms of energy, protein, minerals, vitamins and absence of pathogens such as Salmonella and E Coli as well as Mycotoxins. The correct ingredients included in appropriate ratios for each type of animal and feed is essential for optimal performance and wellbeing of poultry. Effectiveness of growth is calculated as the feed conversion ratio of feed needed per kg of broiler growth or kg of eggs, feed quality plays a critical role in this regard. Storage of raw materials in Tanzania needs urgent attention. When raw materials are not stored correctly, mould growth is experienced, particularly more challenging in high humidity conditions typical in Tanzania. Mould growth leads directly to the formation of mycotoxins in raw materials, which have significant health and performance implications for poultry. The use of mycotoxin binders in feed to assist with the problem is advocated but this is a partial remedy and not a solution.

Registration and regulation of feeds is an important step in ensuring that the quality of animal feed is maintained. Standards that have been set need to be adhered to and policed, even if on an industry voluntary basis. The setting of standards over time in Tanzania has been making progress but there is a perception that the less policed nutrients are compromised in order to reduce costs.

Quality of feed is not only nutrient content but also the use of good quality raw materials. Monitoring levels of undesirable substances such as mycotoxins and bacteria (e coli & Salmonella) is also of critical importance. Adulteration of feed in the less formal market also appears to be a risk. The adulteration of feed in Tanzania is a practice which is of concern particularly in subsistence production. We are aware that nutrient densities required by slower growing birds are significantly less than commercial chickens but indiscriminate mixing of alternative

raw materials such as maize bran imbalance diets especially in mineral content where calcium is essential for egg formation. With the increase of modern quality conscious feed producers, progress is being made in the supply of quality feeds. Getting the correct mix of carbohydrates, proteins, vitamins and minerals is a precise science and is the difference between a good and bad farmer as well as good and bad quality poultry products. The more commercialised the operation and the more advanced the genetics, the higher is the impact of good quality feed. The use of balanced quality feed has to be promoted through effective extension services.

3.3.3 Feed ingredients

A large contribution to the cost of feed is the source of energy. The main source of energy in poultry feeds is maize. In a well-develop feed and human market like in South Africa, maize for animal feed competes with maize for human consumption. Like other East African and Sub Saharan African countries, white maize is the main source of energy in human diets in Tanzania. In 2017/18 Tanzania produced 5,4 million tons of maize, of which out of a total consumption of 5,27 million tons only 870 000 tons was used for animal feed (USDA 2018). The export and import of maize is opportunistic and often not significant, although exports did rise to an estimated 250 000 tons in 2017/18. Maize prices are also extremely volatile. The current price of maize in Tanzania is approximately USD153/ton compared to a price of well over $400/ton in the past season. This can be compared to the current USD164/ton out of the USA, USD162/ton in South Africa, USD163/ton in Argentine and USD174 out of Brazil, which implies that Tanzanian maize is very competitively prices. However, the government introduces an export ban on an ad hoc bases, which has an adverse impact on active private sector investment and participation in the formal trade market for maize. Tanzania has expanded maize production significantly over the past decade and unless there is a drought, it is self-sufficient in most of the years despite of the fact that average yields are extreme low at around 1.3t/ha. Hence, Tanzania has the potential to produce far more maize to supply to any future need in the feed market by just improving the productivity.

Soybean is a crop that has been neglected in Tanzania and resulted in soybean meal in livestock feeds depending on soybean meal imported from India, Zambia and Uganda. However, substantial land is still available for soya production to comfortably meet the local demand for the feed and the human market. The use of locally produced soybeans to manufacture full fat soya, expeller soybean meal or high protein solvent extracted soybean meal would increase the demand for soybeans and increase income/profitability of the farmer. The cost of poultry feed will be reduced, enabling poultry farmers to increase their income. The lack of processing facilities for soya in Tanzania has hindered the promotion of soya production. The potential demand for soybeans for the livestock industry is currently estimated at over 150 000 tons per year. National soybean production is still low but has been increasing. In 2014/15 it is estimated that 5900 hectares were planted to soybeans with a very low yield of 1 ton per hectare resulting in a total production of 6000ton production (Ministry of Agriculture, Livestock and Fisheries 2016).

TABLE 5: INGREDIENT COSTS COMPARISON TANZANIA AND SOUTH AFRICA

	Tanzania (USD/ton)		South Africa (USD/ton)	
Maize	139		172	
Soya Oilcake	496		433	
Sunflower Oilcake	180	(Low protein)	279	(High protein)
Wheat Bran	159		161	
Maize Bran	159		165	
Lucerne	497	(Pellets)	230	(Meal)
Monocalcium Phosphate	719		489	
DL Methionine	4685		2307	
Lysine	1958		1329	

Finding the right ingredients to supplement or replace inaccessible ingredients is a necessity for a poultry farmer that needs to be profitable. The question is what the optimal price and quality of feed formulation is using ingredients that are readily accessible. Besides the major macro raw materials, a lower volume but much higher value group of raw materials/concentrates need to be added to make a balanced feed. These are mainly, mono calcium phosphate, amino acids (Lysine, methionine and threonine), Choline chloride, vitamins and micro minerals, enzymes, coccidiostats and growth promotors.

Lastly, there are no or limited premix manufacturers in Tanzania. The result is that in most cases a mixture of these ingredients in the form of a concentrate need to be imported. The main countries of origin are Kenya and South Africa.

3.3.4 Feed costs

In terms of rout to market, commercial farmers purchase directly from feed mills in bulk. Due to the larger volumes and shorter supply chain, feed is obtained at a lower price than small to medium producers. In the case of small-scale farmers, feed is mainly sourced through local traders and distributers as well as millers in the rural areas. These are smaller volumes of bagged products which are often sold at higher prices than feed to the larger commercial consumer. These sales can be extended to medium sized traders and millers both in rural and urban areas. A large portion is distributed through shops, agrovets and resellers close to producers. Clients need to arrange own logistics to source the feed. The quality of feed is not always guaranteed due to the fact it could have been remixed before reaching the end consumer.

Feed prices in Tanzania are high, mainly due to high margins and imported soybean meal and concentrates/premixes. Comparing current feed price in Tanzania to that in South Africa, we find a dramatic difference with South African broiler feed currently priced at 62% of the Tanzanian equivalent and layer feeds priced at 68% of the Tanzanian price. Table 6 compares the current level of feed prices in Tanzania and South Africa. In Tanzania, the weighted average for broiler feed is **$581/ton** and **$452/ton** for layer feed compared to South Africa where the weighted average for broiler feed is **$332/ton** and **$259/ton** for layers (SAPA 2018).

TABLE 6. FEED PRICES IN TANZANIA COMPARED TO SOUTH AFRICS (USD/TON)

	Tanzania Feed Prices		South African	
	Company A	Company B	SAPA	Company A
	USD/ton	USD/ton	USD/ton	USD/ton
Broiler Starter	590	544	340	370
Broiler Grower	583	527	332	363
Broiler Finisher	574	527	324	346
Weighted Average	581	532	332	359
Layer Feed	452	351	259	287

Table 7 compares the import parity prices for SA feed landed in Tanzania to the current prices of the local product. The results indicate that South African broiler feed could possibly be imported at a lower price than

Tanzanian broiler feed into Dar es Salaam, however once the overland transport costs of $95/ton have been incurred between Dar Es Salaam and Arusha, the South African broiler feed is no longer competitively priced. The layer feeds are much more expensive from South Africa, this could be partially as a result of the density (quality) of the ration and the high inclusion of cheaper milling by-products.

TABLE 7. FEED PRICES TANZANIA COMPARED TO SOUTH AFRICA (SA) FEED DELIVERED TO DAR ES SALAAM (DAR)

	SA in Dar	SA in Aruasha	Tanzania A	Tanzania B
	USD/ton	**USD/ton**	**USD/ton**	**USD/ton**
Broiler Starter	516	611	590	544
Broiler Grower	584	679	583	527
Broiler Finisher	577	672	574	527
Weighted Average	559	654	581	532
Layer Feed	516	611	452	351

The feed recommended and sold for the purpose of raising the Kuroiler and Sasso is not the same as commercial broiler starter. The diet is lower in density with the purpose of sustaining the slower growth of these type of birds. It is advised not to feed a commercial broiler starter feed to these type of birds as it will result in faster growth and higher mortality. The price of this type of feed was established from Company B as $435/ton (Table 8).

In the case of commercial broiler and egg production, feed costs account for approximately 50% (VC 1b & 2b) to 70% (VC 3) of total production cost. Dependent on the weight, age, rate of growth, rate of egg production, environment and other factors, birds have different nutrient requirements for optimal performance. There is considerable debate about what the advanced duel-purpose hybrid birds like a Kuroilor or a Sasso diet nutrient profile should look like considering the variety of other feed materials that will be consumed and the fact that a meat and egg producing bird are being fed one single diet.

In VC 3 broilers are fed at least three rations until slaughter at approximately 32 days. During this period if achieving Cobb standard (Cobb 2018), the broiler will achieve a body weight of 1.89kg and consume approximately 2,8 kg of feed (Feed conversion 1.48). Considering the feed costs indicated in Table 8, the cost of feeding a commercial broiler from day old to slaughter in Tanzania on feed from Company B (USD532/ton) will be USD1.49 per bird while in South Africa on feed from Company A (USD359/ton) feeding the same bird will only cost USD1.00 per bird. In most cases, the breeds like Kuroilor or Sasso are fed a starter feed only for the first 4 weeks after which alternative raw materials and feeding on waste is the norm. Considering the Kuroiler is expected to weigh 2kg at 10 weeks, the feed cost would be USD1.17/kg of broiler meat. It is clear that it cannot be economically viable to continue feeding these birds on commercial feed only. There will have to be a scavenger/waste element added. The assumption has been made that if sufficient scavenger/waste feed is brought into the programme that feed costs could be reduced by 50% (The Kyanja Bullitin 2016) which will imply USD 0.585/kg broiler meat.

TABLE 8: FEED COSTS TO PRODUCE A KG OF BROILER MEAT

	VC1a	VC 1b & 2b (no waste)	VC2b (plus waste)	VC 3
Feed quantity to produce 1 kg		2.69	1.34	1.48
Feed price per ton (USD)		$435/ton	$435/ton	$532/ton
Feed costs per kg of broiler meat		$ 1,17/kg	$ 0.58/kg	$ 0.78/kg

3.3.5 Challenges and opportunities in the feed market

Challenges

-Several regulatory bodies making ease of business and supply of raw materials problematic

-Shortage of feed experts

-Unpredictable business environment has resulted in a shortage of day old chicks

-Availability of raw materials such as phosphorus, amino acids and enzymes etc as opposed to less cost-effective concentrates

-Timeous payment of feed accounts and financial support

-Increasing size of production to take advantage of economies of scale

Opportunities

-The industry is young and has significant room for investment and growth

-Potential employment by both formal and informal sector

-Value that can be added to both agricultural products and by-products

-Reduction in raw material costs making feed prices more competitive

-Increase the amount of integrated poultry producers

-Producing better quality feeds

-Optimising the use of lower costs raw materials as substitutes for maize and soybean meal

4. Summary findings and conclusions

Policy:

Challenges	Interventions
1. The continuous introduction and removal of VAT has a significant impact on broiler producers, who use feed very intensively and policy uncertainty is not conducive to investment to increase production. 2. National standard for feed quality is positive with respect to formal standards, yet some of the norms in the regulation (like the 15% oil content requirement on oilcake) is not conducive.	1. Removal of VAT on feed provided significant relief to economics, yet over the past years there has been great variability around VAT. Consistency in the implementation of a zero-VAT policy on feed is critical. 2. Remove 15% oil content requirement on oilseed cake (e.g. sunflower oilcake). 3.

Value chain:

Challenges	Interventions
1. VC 1: - Very low costs system, yet productivity is very low and poor genetics. - Limited vaccination, major risk in decease management (New Castle, Avian Influenza, Gumboro). This holds risk for the total bird population in Tanzania 2. VC 2: - Tanzania has no grandparent farms and is thus a net importer of parent stock for both broilers and layers. - Limited availability of fertilized eggs and day-old chicks. - With limited feedmilss and premix manufacturers, poultry farmers are facing excessive prices and margins on feed and quality is not guaranteed. - The adulteration of feed in Tanzania is a practice which is of concern particularly in subsistence production.	1. VC 1: - Introduction of better genetics & poultry training - Investment in breeder farms and hatcheries to supply DOC to households 2. VC 2: - Investment in poultry breeder farms and hatcheries will improve the availability of day-old chicks. - Introduction of better genetics & poultry training - Investment in breeder farms and hatcheries to supply to small commercial producers - The use of balanced quality feed has to be promoted through effective extension services. - Training and extension services critical to promote the principles of productive high-performance birds

- Storage of raw materials in Tanzania needs urgent attention. - Major risk of cross breeding traditional and hybrid chickens will result in loss of genetics and performance of new breeds - Access to sufficient credit provides major constraint due to lack of collateral or fixed off-take agreements	- Access to affordable and good quality feed remains a challenge. Investment in more feed processing plants and premix manufactures will support lower feed prices and better quality in the end. - Good quality feed not only depends on nutrient content but also the use of good quality raw material. - Expansion in soybean production to provide consistent supply to feedmills below import parity prices.
3. VC 3 - Tanzania has no grandparent farms and is thus a net importer of parent stock for both broilers and layers. Investment in poultry breeder farms and hatcheries will improve the availability and costs of day-old chicks - Excessive prices and margins on feed and quality not guaranteed. - Storage of raw materials in Tanzania needs urgent attention. - TAN is dominated by traditional live bird market in urban and rural areas. Very strong consumer preference for traditional chicken meat ("Kuku Kienyeji") with a willingness to pay a premium for this meat in the informal markets in urban and peri-urban centres. - Lack of formal retail, fast food chains that can boost affordable good quality chicken - Lack of slaughtering facility and cold chain facilities -	3. VC 3: - Feed prices in TAN still significantly higher (30% plus) than country like South Africa. Investment in more feed mills, less bureaucracy in habour and investment in transportation infrastructure critical to drive down costs. - As the frozen processed market is developing over time, cheap imports from EU/Tailand/Ukraine can provide significant competition if the current import tariff on meat is removed - Expansion in soybean production to provide consistent supply to feedmills below import parity prices.

Annexure

A1 Practical guidelines of feeding various breeds

The use of commercial, indigenous, Kuroiler and Sasso for the production of meat and eggs requires the attention of the feeding requirements and practices for all three categories of birds.

In the rural areas chicken production is almost exclusively indigenous type of chickens or Kuroiler and Sasso. These chickens also contribute to an estimated 20% of eggs consumed in rural and urban areas.

Feeding commercial breeds

The technology of how to raise and feed modern poultry breeds is well established and down to a fine art. Companies such as Cobb (Cobb 2018) and Ross (Ross 2018) for broilers and Hy-line (Hy-line 2018) and Lohmann (Lohmann 2018) for Layers have become precise in feed specifications and requirements. There is little doubt that top of the range high density rations not only produce the best results for these poultry but in addition most likely the most cost-effective solution.

Layers

Commercial layers are fed ad lib during rearing and laying. Typical performance expectations and quantities of feed consumed are outlined below.

1) Rearing Hy-line Brown for laying

Liveability 98%

Feed consumed 5,75 – 6,13 kg

Body weight at 17 weeks 1,4 – 1,48 kg

2) Laying period to 100 weeks

Percent peak 95 – 96 %

Hen housed eggs to 60 weeks 253 – 262

Hen housed eggs to 60 weeks 408 – 421

Hen housed eggs to 60 weeks 453 – 467

Livability to 60 weeks 97%

Livability to 100 weeks 92%

Days to 50% production from hatch 140 days

Egg weight at 70 weeks 62.9 – 65.5 g/egg

Egg weight at 100 weeks 64 – 66.7 g/egg

Body weight at 70 weeks 1.91 – 2.03

Body weight at 100 weeks 1.92 – 2.04

Average daily feed consumption (18 – 100 weeks) 105 – 112 g/day per bird

Feed Conversion kg feed / kg Eggs (20 – 60 weeks) 1.87 -1.99

Feed Conversion kg feed / kg Eggs (20 – 60 weeks) 1.98 -2.1

Broiler breeders

Broiler breeders are fed a starter ration from 0 to 28 days, a grower ration from 29 to 126 days, pre-breeder 127 to 154 days, breeder phase 1, 155 to 280 days, breeder phase 2, 280 days until depletion, males should be fed a separate ration from 155 days until depletion.

Females are fed ad lib for the first week during rearing (they should consume between 22 and 25 g/day) thereafter their feed intake is restricted to ensure they do not exceed target weight by 4 weeks of age, to have proper uniformity and frame development. During rearing a 5 day per week feeding is common to control body weight, at 8 to 9 weeks of age birds will be consuming 371 grams per week. Feed clean up time must be under 4 hours.

Breeding flocks should obtain a peak production of between 87 and 91%. Feed quantity is restricted to result in a clean-up time of 3 hours for mash or 1.5 hours if crumbles are being fed. Over or under feeding will affect peak production or production persistency. Peak production is determined by the uniformity, the body weight and the feeding program in the rearing period. The weight gain of females should be measured from the onset of lay until to the age of peak production. There should be an 18% increase in female body weight over this period.

TABLE A1. NORMAL FLOCK BEHAVIOUR

Age (weeks)	Body weight (grams)	Feed consumption (g)	Production (%)
24	2900	115	2
25	3000	118	20
26	3100	128	44
27	3200	140	65
28	3300	152	79
29	3380	160	86
30	3440	160	86
31	3480	159	86

Feed allocation to females increase every 3 days from onset of production, the norm would be increasing from 115 grams at 5% production to a maximum feed allocation of 163 grams at 86% production. At 75% production the maximum feed allocation of 163 grams should already be reached. The average feed allocated over this period will be 135 grams per day.

Feeding and management practices must be applied to allow the correct development of the male's reproductive system. The male's growth profile is the single most important criteria that correlates with flock fertility. Males need to be weighed weekly from 1 to 30 weeks and every other week after that.

A good start in rearing males is crucial for weight uniformity and good organ and skeletal developments. Males should be reared separately from females until housing at 20 weeks of age. Enough light must be supplied to ensure that the proper amount of feed is consumed in the first 4 weeks.

It is highly recommended to use separate sex feeding in production. Males should have no access to female feed and vice versa. Male to female ratio at transfer are 7 to 9% for closed houses and 9 to 10% in open houses.

TABLE A2. BODY WEIGHT TARGETS

Weeks	Body weight Females	Body weight males
20	2250	2725

25	3105	3485
30	3570	3970
40	3770	4240
50	3915	4460
60	4015	4685

Separate sex feeding is practiced by supplying giving males' specific feeders after transfer from the rearing house at 20 weeks of age, small increases in feed are required 3 to 4 grams per week from 20 to 30 weeks. If the male is fed too much after transfer the result will be continued male body weight growth producing heavier males that will need more energy for body maintenance. The Cobb standard for male body weights is designed to keep male light early in production, not more than 4kg at 30 weeks and have consistent growth of a maximum of 25 grams per week from 30 weeks to depletion at 60 weeks (approximately 4.7 kg body weight).

TABLE A3. PERFORMANCE PARAMETERS

		Dark Out	Open sided
Age at depletion	(days)	420	455
Age at 5% production	(days)	168	168
Total eggs/hen housed		166.2	181.3
Hatching eggs/hen housed		161.5	176.3
Peak hatchability		90	90
Cumulative hatchability		86.2	85.6
Broiler chicks/hen housed		139.2	150.9
Livability from 24 weeks		92.8	92.3
Female body weight 24 weeks		2.9	3.01
Female body weight 65 weeks		3.95	4.04

1) Feeding commercial broilers

Irrespective of feeding system feeder space is critical to allow maximum broiler growth and bird uniformity. Pre-Starter feed is supplied in the form of a crumb placed on lids, trays, paper used as supplementary feeders between feeders. Feeders should never be allowed to run empty. Seven-day weights and feed conversion is the ideal way to evaluate how effective brooding has been. Poor seven-day weights will result on overall poor broiler performance.

The composition of feed must supply essential nutrients in the correct ratio (water, amino acids, energy, vitamins and minerals) for optimal skeletal development and muscle deposition. The quality of raw materials used in rations, form of the feed and hygiene of the feed will have a direct impact on bird performance. Diets must be adjusted depending on several variables table Y.

TABLE A4. VARIABLE REQUIRING DIETS ADJUSTMENTS

Variables requiring diets adjustments
a) Raw material availability and cost

b) Separate sex growing
c) Live weights required by the market
d) The value of meat and carcass yield
e) Fat levels required by specific markets
f) Skin colour
g) Meat texture and flavor
h) Feed mill capabilities

Feed form can differ from mash, crumbles, pellets or extruded product. Pelleted feed shows a definite advantage in performance both in feed efficiency and growth rates over mash feed.

Nutrient requirements decline with broiler age and for this reason it is common to feed a starter, grower and finisher diet to match the bird's nutrient requirement. The greater the number of feeds the more likely nutrients supplied would meet demand, the number of feeds is however constrained due to practical considerations.

Diets need to have a nutrient rich composition to promote optimal live weight gain and feed conversion.

Feeding indigenous breeds

Feeding Kuroiler and Sasso

Kuroilers have been devolved to be suitable for backyard farmers and can be used for meat and egg production with minimal provision of commercial feeds. These birds have been shown to perform well on kitchen and vegetables waste. They grow faster than local birds and have a similar taste, are more resistant to disease than exotic birds. After 14 weeks, birds can reach 3kg. Female birds start laying at 4 to 5 months. Feeds account for over 70% of cost of production of not only commercial chickens but also Kuroilers, therefore how they are fed should get attention. Due to the high feed intake, slower growth and poorer conversion when compared to commercial chickens it is suggested that it would not be cost effective to grow Kuroilers on commercial feed only. The advantage of the Kuroiler over commercial chickens is that they can eat left overs and vegetable waste and still gain weight. This is one of the major aspects that makes them economically viable. Feeding of Kuroilers on kitchen left overs and organic waste can reduce the cost of feeding by up to 50%. In the case of slow growth chickens such as the SASSO (SASSO, 2018) which only are targeted to achieve 2,4 kg at 84 days at a very low average daily gain (ADG) of 30 grams information is less precise.

TABLE A6. QUANTITY OF FEED CONSUMED BY KUROILERS TO 10 WEEKS OF AGE

Age	Feeds/bird/week
4 weeks starter	0.49
5 weeks finisher	0.63
6 weeks finisher	0.84
7 weeks finisher	0.84
8 weeks finisher	0.84
9 weeks finisher	0.84

10 weeks finisher	0.91
Total	**5.39**

Good early growth is essential and get the SASSO off to an early start, the farmer has a very important role to play in this regard. Once the chicks have taken water it is imperative to supply a well-balanced, easily digestible, fresh starter feed on flat chick feeder trays or plates for the first 3 days. Sample chicks 3 hours after arrival and 98% need to have full crops. It is advised not to force the birds to grow too fast by feeding a broiler finisher, this will affect the flavour and texture of the meat, it is advised to grow the birds slowly to 8 to 10 weeks. It is also advised that after 3 weeks the birds can be allowed to roam outside but must get 80% of their feed inside and sold at the live weight desired by the customer.

We do know one of the advantages is that we can use cheaper less dense rations. Feed rations could contain higher levels of milling by-products such as maize bran, some soybean meal could possibly be replaced with lower protein expeller sunflower oilcake. Where formal compound feed is not available it could still be viable to raise these types of poultry.

TABLE A7. FEED COMPANIES OPERATING IN TANZANIA (TAFMA 2018)

S/NO	NAME	BRAND NAME
1	Hillary Shoo	Hill Animal Feeds
2	Dr Hendry Ruhinguka	Mult Animal Feeds
3	Seif Amour Seif	Mitunda Animal Feeds
4	Luka Richard	Best Animal Feeds
5	Lucas Daud	Tabhoka Quality Mills
6	Nanu A Msele	Nanyuki Animal Feeds
7	Jackson Matutu	Matutu Animal Feeds
8	Cassian N'Gamilo	Mama Kuku Feeds
9	Aloyce F Msaki	Lengesha Animal Feeds
10	Godwin A Mrema	Kerege Animal Feeds
11	Joseph Steven	Best Animal Feeds
12	C $ C Animal Feeds	C $ C Animal Feeds
13	Rwehangira Steven Peter	Amani Chicks
14	Boniventure B Ishengoma	Mhega Investment
15	Ally Hassan	Steve Animal Feeds

16	Kelvin Mwijage	Brand Poultry
17	Seleman M Lusinga	Mkojela Animal Feeds
18	Boaz Magito	BM Animal Feeds
19	Sweya Omari	Mkombozi Animal Feeds
20	Jonathan Mgomi	Suma JKT
21	Sia Lekule	Tanfeeds
22	Hassan A Ahmed	Falcon Animal Feeds Ltd
23	Humoud M Mselem	Quality Feeds
24	Moses Temu	Rich Animal Feeds
25	Leonard Lema	Lenny Animal Feeds
26	Peter Mapunda	Kiluvia Millers
27	Juma Kimvuli	Kimvuli Animal Feeds
28	Michael Thomas	Kitunda Animal Feeds
29	Joseph Mbago	J M Animal Feeds
30	Chausiku B Kyango	Apia Animal Feeds
31	Veronica Mbuya	A To Z Animal Feeds
32	Hafidh H Mansoor	Nassad Animal Feeds
33	Martin M Nghoni	Shaloom Animal Feeds
34	Timas	–
35	Energy Chicken Feeds	Energy Chicken Feeds