SOUTHERN AFRICAN INSTITUTE *for* POLICY AND RESEARCH

Affordability of Protein-Rich Foods:
Evidence from Zambia

CDC 70 Investment works 1948-2018

RapidInsights

Foreword

The publication of this report could not be more timely, coming on the heels of the 2018 African Green Revolution Forum (AGRF) at which data, information, technology and knowledge sharing were all highlighted as critical aspects of Africa's ability to feed herself.

Investing in the food and agriculture sector can deliver enhanced economic opportunities, improved nutrition and more resilient supply chains in line with the global Sustainable Development Goals (SDGs) 1 (no poverty), 2 (zero hunger) and 8 (decent work and economic growth). In this context, enhancing the affordability of nutritious foods is an urgent cross-cutting priority – and a key route through which investors like CDC create lasting impact.

Of all the products and services across Africa, the affordability of food is particularly important. Food spending is, by far, the largest component of household budgets – accounting for almost half of all spending in many of our markets, with the highest burden falling on low income households.[1] Enhancing the affordability of food spending therefore presents a huge opportunity to create budgetary space at a household level – freeing up buying power to be spent on more food, more nutritious food, or elsewhere entirely. This extra buying power is most likely to be funnelled towards products or services with high income elasticities – in Zambia, for example, this includes out-of-pocket spending on: education, communications, house rent, water and sewage, electricity and transport. It is these products and services that are therefore most likely to benefit most from the budgetary space potentially generated by the enhanced affordability of food. Enhancing the affordability of food is about far more than just food – it is about everything that households aspire to buy.

Access to affordable, nutritious foods is especially critical when almost one in five people in sub-Saharan Africa, and one in six people in South Asia, remain undernourished. We recognise this is one of many factors related to food security and undernourishment. CDC is invested – directly and indirectly – in over 110 businesses in the food and agriculture sector across the value chain, valued at over $400 million, within which our largest platform business in the sector is Zambeef Products plc. Leveraging this, CDC has partnered with Zambeef and independent researchers to better understand how commercial producers and distributors can, and do, enhance the affordability of protein-rich foods to low income and underserved populations in Zambia.

Before this report, CDC commissioned an independent review of the evidence (McKee, 2017) for internal purposes on the affordability of commercially produced and distributed, protein-rich foods in sub-Saharan Africa with a focus on Zambia. The key messages were that:

1. There is a substantial need to increase animal protein consumption in sub-Saharan Africa to enhance healthy development of children and adults.
2. Only weak evidence and data exists on the affordability of processed foods in sub-Saharan Africa.
3. Different sub-populations experience the affordability of protein-rich foods in unique ways (most clearly with an urban/rural divide).
4. Interventions further up the value chain (indirect interventions helping to lower input costs) may have substantial impact on affordability, but these have not yet been quantified.
5. There is a need for actionable propositions on how commercial producers and distributors of protein-rich foods can enhance affordability.

1 CDC analysis using data from the Ethiopia Socioeconomic Survey, Wave 3 (2016), Liberia Household Income and Expenditure Survey (2015), Malawi Integrated Household Panel Survey (2013) and Zambia Living Conditions Monitoring Survey VII (2015).

This report seeks to go a step further, focusing on how commercial producers and distributors can, and do, enhance the affordability of protein-rich foods to low income and underserved populations in Zambia. We hope it helps to hasten the efforts of industry, investors and policy-makers toward enhancing access to affordable, nutritious foods – given what is at stake.

Endowed with over 40% of southern Africa's water source, sparsely populated arable land and an industrious people, Zambia has the potential to become a pivotal contributor to smart foods and food security for the region.

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2 This paper does not represent the views of CDC Group and is editorially independent.

Acronyms and abbreviations

ASF	Animal source foods
CSO	Central Statistical Office
DAZ	Dairy Association of Zambia
DHS	Demographic and health survey
DRC	Democratic Republic of the Congo
LCMS	Living Conditions Monitoring Survey
NGO	Non-governmental organisation
SMEs	Small and medium-sized enterprises
ZDHS	Zambia Demographic and Health Survey

Contents

Executive summary

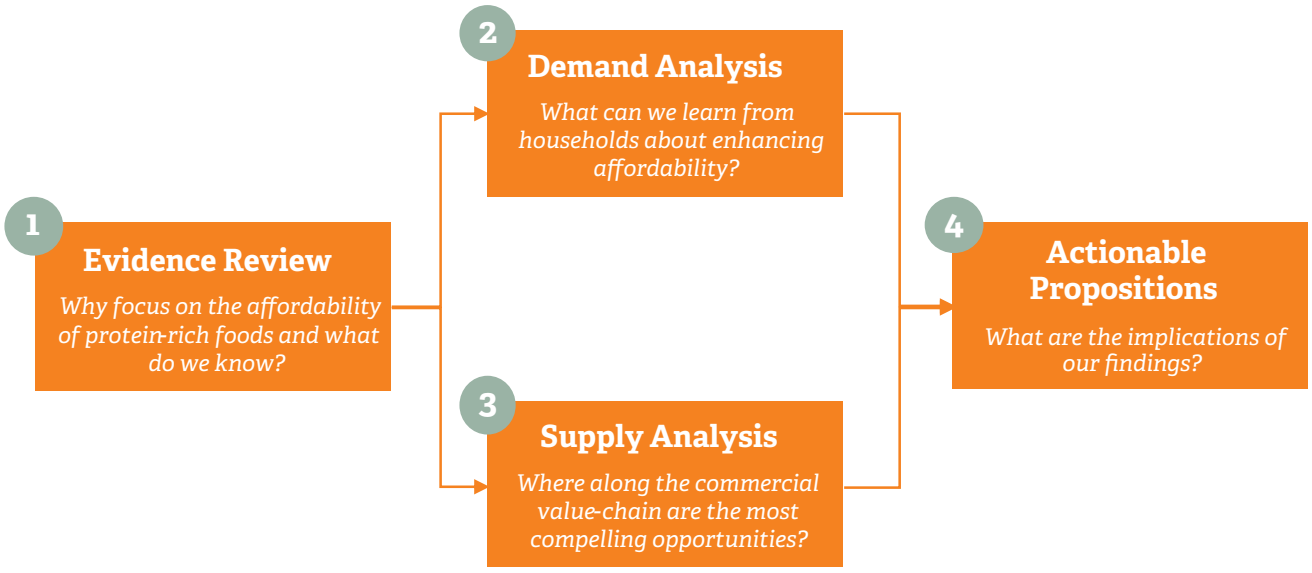
This report explores how lower prices and reduced costs of access can enhance the affordability of protein-rich foods in Zambia – particularly for low income and 'underserved' populations. The report focuses explicitly on Zambia in part thanks to the availability of primary data, but it is hoped that the approach and many of the findings will have broader relevance across the African continent. We understand this to be the first study of its breadth – with coverage across five important food value chains (aquaculture, poultry meat, eggs, beef and dairy) – completed for Zambia.

Protein-rich foods and animal-sourced proteins in particular are a critical foundation for physical and mental development. Despite the importance of proteins, their consumption is lagging in many of the poorest parts of the world, especially across sub-Saharan Africa. In Zambia specifically, child stunting rates remain alarmingly high at 40 per cent, in large part because of poor nutrition. Overall, only 11 per cent of children aged 6–23 months were fed appropriately based on recommended infant and young child feeding practices (ZDHS, 2014). More broadly, Zambia has experienced a notable decline in the availability of animal source foods since the early 1960s.

Affordability (including costs of access) should be seen as a key factor limiting consumption of protein-rich foods since in Zambia spending on food makes up 41 per cent of overall household income (35% for urban households and 56% for rural households). Unsurprisingly, commercial producers and distributors have tended to focus on high income urban populations given that these groups are typically easier to reach and spend more on food – nearly 3.5 times that of 90 per cent of the rural population (LCMS, 2015).

This report asks whether the production, marketing and distribution strategies of the large commercial players are too narrowly focused on the higher income urban population, which is well-integrated with food value chains in Zambia. This population is mostly concentrated in the corridor running from Lusaka through Copperbelt province and extending to Lubumbashi in copper-rich southern Katanga province of the Democratic Republic of the Congo (DRC). We find evidence that businesses may be missing out on opportunities to develop production, packaging, pricing and distribution strategies or even entirely new business models that would enable them to sell more of their protein-rich foods to low income and typically underserved consumers in Zambia's predominantly rural provinces.

This study tackles this challenge through four distinct activities as illustrated here:



1. **Section 1 presents an evidence review**, focused on the importance of protein-rich foods, the current landscape in Zambia and pathways to enhance access to affordable protein-rich foods.
2. **Section 2 presents a demand-side analysis** titled 'listening to customers: what we can learn from buying behaviours – summarising key lessons from speaking to over 1,700 Zambians on how to better serve low income and typically underserved households.
3. **Section 3 presents a supply-side analysis**, titled 'mapping the supply side: where are the opportunities along the value chain,' systematically mapping value chains for poultry and eggs, dairy, beef and aquaculture – to identify opportunities to drive down prices (via production costs) and costs of access for consumers.
4. **Section 4 concludes with actionable propositions**, articulating the way forward for enhancing access to affordable protein-rich foods across our focus value chains in Zambia – briefly summarised in the following figure.

What can we learn from buying behaviours?

- Low income consumers spend less per household but still account for a large proportion (43%) of the overall market. These households are harder to serve (lower expenditure, greater geographical dispersion, etc.) but nonetheless present a compelling commercial opportunity
- The greatest opportunities to enhance the affordability of protein-rich foods to low income households appear to be in dairy, fish and chicken (particularly in urban areas)
- For households typically underserved by large formal retailers, regardless of income level (typically rural households), enhancing the supply of affordable, quality fish in particular appears to present the greatest single opportunity
- These underserved households also appear to see value in commercial retailers – going further afield at least once a month to large, commercial retailers.

What can we learn from analysing value chains?

Across multiple value chains, similar core themes reoccur, including:

- Opportunities to support SMEs (suppliers and customers) with more robust supply-chain finance, allowing them to accrue the benefits of greater scale and drive down production costs
- Opportunities to aggregate SMEs (through cooperatives, shared collection centres, etc.) to which inputs, extension services and off-takers could focus
- Opportunities to target private investment at bottlenecks in value chains (e.g. aquaculture hatcheries or processors) to increase competition and drive down production costs.

Opportunities to enhance affordability across protein value chains

Aquaculture

- Investing in high protein soybean meal for animal feed to reduce production costs
- Investing in rural distribution channels to drive down costs of access
- Supporting outgrower schemes and cooperatives to boost domestic SME production
- Investing in solar refrigeration to support the distribution of farmed fish in rural areas
- Promoting awareness of fish as a low-cost, high-quality protein source

Dairy

- Incorporating smallholder cooperatives into the supply chains of dairy processors to boost domestic production
- Enhancing the supply of vitamin and mineral premixes as an input to SMEs and dairy cooperatives to reduce production costs
- Promoting awareness and school-feeding programmes to boost local demand

Eggs

- Supporting major producers of animal feed and day-old-chicks to extend supply-chain financing and technical support to SMEs to drive down production costs
- Industry wide coordination to import veterinary supplies or provide extension services to SMEs
- Investing in the production of easier to preserve eggs to enhance market reach and protect against seasonal variations

Poultry meat

- Investing in the distribution of inputs and supply-chain financing to SMEs to drive down production costs
- Investing in enhanced cold chain distributions to typically underserved areas
- Investing in nutritional labelling to raise awareness of chicken as a high value-for-money source of protein
- Supporting expansion of outgrower schemes to guarantee offtake from SMEs when local markets fail

Beef

- Supporting traditional cattle farmers through extension services and promoting value chain integration
- Extending public infrastructure (roads, electricity, cold-chain facilities) to unblock prohibitively high costs for private sector players to reach low-income populations

Notes: SMEs: small and medium-sized enterprises

1. Evidence review

Summary

- Proteins are a critical foundation for physical and mental development, but their consumption in sub-Saharan Africa lags the rest of the world – in Zambia specifically, child stunting rates remain alarmingly high at 40 per cent and there has been a notable decline in the availability of animal source foods (ASFs) since the early 1960s – illustrating the urgency of enhancing the affordability of protein-rich foods.
- Enhancing affordability of nutritious foods is not solely about minimising costs, but also about maximising nutritional value for money. Protein content per 100g of food product purchased should be a key consideration in understanding whether protein-rich foods provide value at an affordable cost.
- Affordability is concerned with the full economic costs (Sanni and Neureiter, 2018) of accessing protein-rich foods, meaning the unit price plus the travel time and expense to obtain them – this paper addresses a full range of these dimensions.
- Although evidence supports its importance, affordability is not the only driver of adoption – other factors include customer awareness, availability of supply, the advantage gained and cultural accessibility. Such factors are mostly beyond the reach of this study.
- Two key levers to enhance the affordability of protein-rich foods are (1) reducing the unit price through minimising production costs, and, (2) reducing the cost of access by maximising distribution channels. To understand the potential to pull on each of these levers, this report conducts a full value chain analysis of major proteins and a deep dive into demand patterns of consumers. To our knowledge, this is the first such study completed about Zambia.
- Higher incomes through robust economic growth will always be the biggest driver of affordability and increased consumption of protein-rich food as the example of a succession of rapidly developing countries in East Asia and elsewhere has clearly shown. Most of the recommendations need sound economic policy as a continued basis to raise more of the lowest income groups out of poverty.

Why focus on proteins?

Protein is an essential micronutrient in the human diet because of its critical role in cognitive and physical development; it is particularly relevant in the early years of life. Deficits in protein consumption can lead to short and long-terms conditions, many of which are irreversible. Chauvin et al (2012) set out how better nutrition in Africa is critical for reducing poverty and improving general well-being. Improved diets promise to contribute significantly to the continent's developmental transformation.

Empirical information about how low income and marginalised groups access protein-rich foods in Zambia is limited. Particularly little is known about how commercial producers and distributors of protein-rich, animal source foods (ASF) can, and do, enhance the affordability of these foods, particularly for low income households and rural populations typically underserved by large commercial players ('underserved populations'). These commercial players are formal producers and

distributors, who are typically well-defined market players in their respective value chains. They represent the best prospect for fostering firm and industry-level market interventions towards delivering more affordable protein-rich foods at scale.

These issues are important for industry practitioners, investors, policy-makers and development partners given their implications for socioeconomic development and poverty reduction. This study seeks to address key information gaps in understanding how commercial producers and distributors can enhance the affordability of protein-rich foods to underserved and low-income households in Zambia. As a result, this report aims to put forward actionable propositions for industry players to consider.

What is the current landscape of protein consumption?

Food consumption in Africa is increasing – but not uniformly, or fast enough. Chauvin et al (2012) review food production, consumption and trade trends in a large sample of 19 sub-Saharan countries (Benin, Burkina Faso, Burundi, Cameroon, Cote d'Ivoire, Ethiopia, Gambia, Ghana, Guinea Bissau, Kenya, Madagascar, Malawi, Mali, Nigeria, Rwanda, Senegal, South Africa, Tanzania and Uganda), combining both macroeconomic data and microeconomic household survey evidence. The study reveals that caloric intake has been increasing in Africa, but not steadily or homogeneously, and not fast enough to secure adequate nutrition throughout the continent.

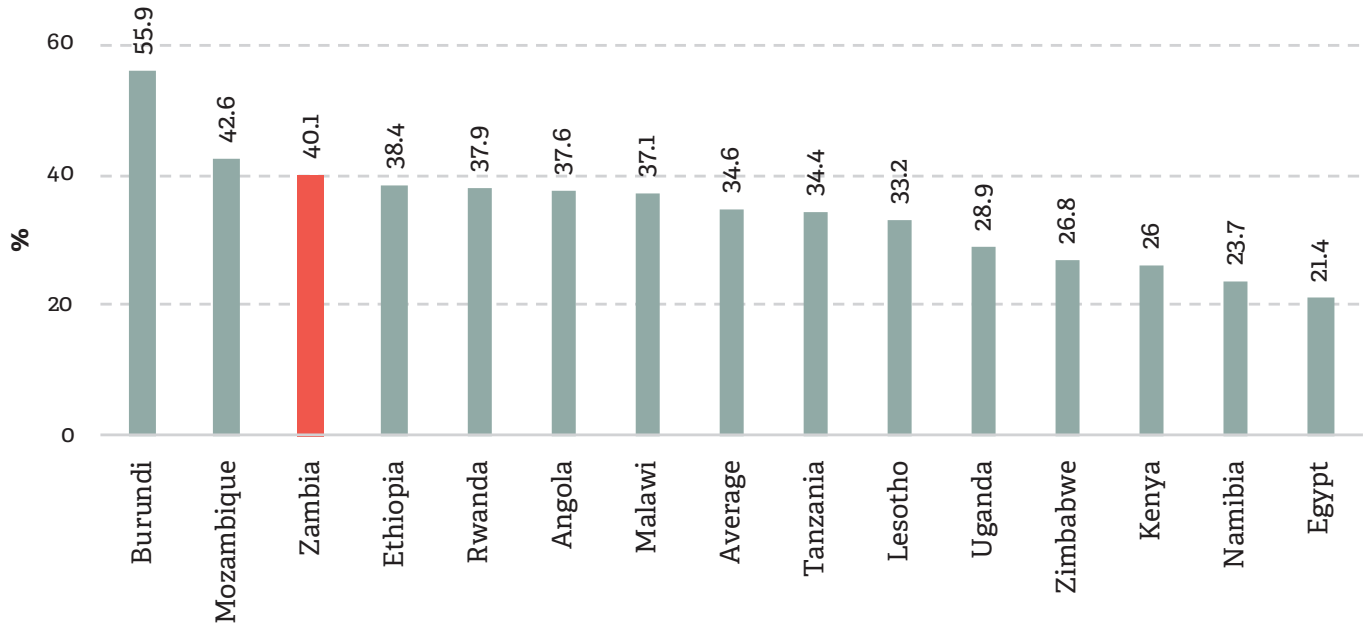
Undernutrition, particularly insufficient consumption of protein, remains a persistent problem in low income countries. Assessing dietary protein quality and malnutrition in Africa, Schonfeldt and Hall (2012) indicate that the average requirement is 105mg nitrogen/kg body weight per day, or 0.66g protein/kg body weight per day – a figure that many low-income countries fall significantly below. They find that while in most high income countries, animal products and cereals are the two most important sources of protein – this order is reversed in low-income countries where animal-sourced protein consumption remains particularly low. In these low-income countries only 3 per cent of total dietary energy – as an indicator of diet composition – is derived from meat and offal; 11 per cent comes from roots and tubers and 6 per cent from pulses, nuts and oilseeds while the remaining 80 per cent of dietary energy is mostly derived from cereals-based staple foods. The key issue is therefore a deficit in the quantity of protein consumed compared with World Health Organization recommendations, though protein quality is a major concern as well.

National nutrition intake tracing studies remain rare given time and resources required. Alaofe et al (2014) revisited the data from a nutrition survey conducted in Zambia's Northern and Luapula provinces (two rural provinces out of ten in the country) in 2008, aiming to fully characterise the dietary patterns and health and nutrition outcomes of children 6–59 months old and women of reproductive age 15–49 years old. The survey found that in these parts of Zambia, as is typical for a poor developing country, intake of meat, fish, poultry and eggs was relatively low, ranging from 25–60 grams/day (or at 43 g/day, on average) compared with the combined intake of beans, nuts and seeds (149–264 g/day).

Evidence suggests that protein consumption is inadequate in Zambia with serious implications for human development. A comparative review of nutritional outcomes among children in Zambia and 13 other eastern and southern African countries (Table 1.1) reveals that Zambia is among the bottom five countries in terms of the proportions of children stunted (40%), children wasted (6%) and children underweight (15%) compared with the group averages on the same indicators of 35, 5 and 14 per cent respectively. Increasing volumes of evidence point towards sources of animal protein in the diet as a key intervention in preventing children from growing too slowly (Headey et al., 2017).

Zambia only fared better than average on the duration of exclusive breastfeeding by mothers, but given poor outcomes on stunting, wasting and underweight children, households in the country clearly need supplementary sources of protein-rich foods.

Figure 1.1: Percentage of children stunted by country



Source: Demographic and Health Surveys (DHS)

Table 1.1: Mother and child nutrition outcome indicators in 14 African countries

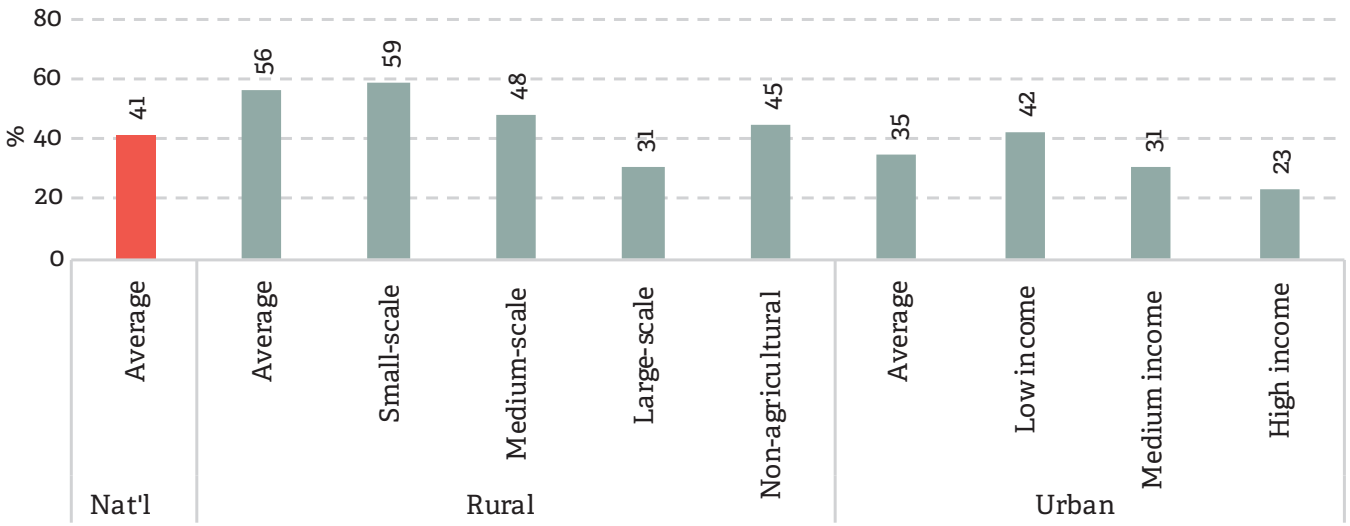
		Children stunted		Children wasted		Children underweight		Median duration of exclusive breastfeeding	
Country	Survey	(%)	Group rank (of 14)	(%)	Group rank (of 14)	(%)	Group rank (of 14)	Months	Group rank (of 14)
Angola	2015–16 DHS	37.6	9	4.8	8	18.5	12	1.8	12
Burundi	2016–17 DHS	55.9	14	5	9	29.2	14	5.1	2
Egypt	2014 DHS	21.4	1	8.4	13	5.5	1	1.8	12
Ethiopia	2016 DHS	38.4	11	9.8	14	23.3	13	3.6	7
Kenya	2014 DHS	26	3	4	6	11	6	3.3	9
Lesotho	2014 DHS	33.2	6	2.8	3	10.3	4	3.9	5
Malawi	2015–16 DHS	37.1	8	2.7	2	11.4	7	3.7	6
Mozambique	2011 DHS	42.6	13	5.9	10	14.9	11	1.1	14
Namibia	2013 DHS	23.7	2	6.2	12	13.3	8	2.2	11
Rwanda	2014–15 DHS	37.9	10	2.2	1	9.3	3	5.4	1
Tanzania	2015–16 DHS	34.4	7	4.4	7	13.5	9	3.5	8
Uganda	2016 DHS	28.9	5	3.4	5	10.3	4	4	4
Zambia	**2013–14 DHS**	**40.1**	**12**	**6**	**11**	**14.8**	**10**	**4.1**	**3**
Zimbabwe	2015 DHS	26.8	4	3.1	4	8.2	2	2.7	10
Average		**34.6**		**4.9**		**13.8**		**3.3**	

Source: DHS

Zambia has experienced a notable decline in the availability of animal source foods (ASFs) since the early 1960s. Zhang et al (2016) observe that there has been a notable decline in the availability of animal source foods (ASFs) since the early 1960s, as the supply of cassava and vegetable oils significantly increased. This shift is partly attributed to the successful introduction of high yielding, drought-resistant, more affordable and more readily available cassava and oilseed crops. The authors examined another policy strategy involving ASF as a mechanism to help remedy micronutrient inadequacy in the population. Their findings offer evidence-based insights into the value of increasing the availability and accessibility of animal proteins to address multiple micronutrient deficiencies and other nutrition challenges related to greater availability of plant-based staples.

Spending on food as a proportion of income is very high in Zambia, especially among the poorest households. Table 1.2 shows the proportion of household budgets being spent on food for different household groups. The high proportions of food spending across different households – ranging from 31 to 59 per cent – demonstrates how households prioritise spending on food compared with other products and services.

Figure 1.2: Percentage of household expenditure on food



Source: LCMS, 2015

Table 1.2: Monthly household expenditure indicators, by location and strata

	Households	Average monthly household expenditure						Poverty
	(millions)	Total (K)	Food (K)	Food (% total)	Own-produced food (% of food expenditure)	Non-Food (K)	Average per capita (K)	% of poor households
National	3.02	1588	645	41	10.8	943	388	54.4
Rural	1.72	763	430	56	30.2	333	172	76.6
Small-scale	1.54	698	411	59	32.8	288	153	78.9
Medium-scale	0.06	1,454	701	48	30.2	753	231	64.5
Large-scale	0.00	3,645	1,113	31	17.0	2,532	742	30.4
Non-agricultural	0.12	1,222	546	45	11.4	677	382	48.6
Urban	1.30	2,680	930	35	3.5	1,750	675	23.4
Low income	1.00	1,893	787	42	4.1	1,106	437	28.3
Medium income	0.17	4,078	1,251	31	3.0	2,827	955	7.3
High income	0.13	6,818	1,596	23	2.7	5,222	2,102	4.9

Source: LCMS Report 2015 (CSO, 2015)
Notes: K=Kwacha

Many households rely on their own production for a portion of their food consumption and income. Levels of own-produced food by household type are detailed in Table 1.2, and Table 1.3 profiles the habits of rural and urban Zambian agricultural households in growing crops, rearing livestock and owning poultry as of 2015. A large proportion of households (83% at national level) grow maize, the staple cereal crop. Countrywide, 55 per cent rear cattle and 55 per cent also rear goats while 97 per cent of farm households keep chickens. The importance of animal husbandry as a source of food consumption rural households is significant.

Despite this, households across the spectrum still buy most of their food – reinforcing the importance of food producers and distributors. As Table 1.2 shows, the average share of food consumption from own-produced sources is 10.8 per cent. Even among small-scale farm households with the highest poverty rates, only 33 per cent or K135 of consumption was own-produced food. The other K276 monthly or 67 per cent was purchased (or gifted) – showing that even very poor households buy a significant proportion of their food. Given this reliance on commercial sources of food, this report seeks to understand the business opportunity for enhancing the affordability of protein-rich foods to low income and typically underserved households in Zambia.

Table 1.3: Crop, livestock and poultry habits of agricultural households in Zambia

	Households	Agricultural households		Growing maize	Growing cassava	Growing millet	Growing mixed beans	Growing soya beans	Growing groundnuts
	(millions)	(millions)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
National	3.02	1.77	58.7	83.4	22.1	4.6	11.2	4.5	31.3
Rural	1.72	1.54	89.4	83.8	23.9	5.2	12.0	4.9	32.8
Urban	1.30	0.23	18.0	80.1	10.1	1.1	6.0	2.3	21.8

	Households	Agricultural households		Rearing livestock	Rearing cattle	Rearing goats	Rearing pigs	Rearing sheep	Owning chickens
	(millions)	(millions)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
National	3.02	1.77	58.7	34.4	55.1	54.6	30.9	1.6	96.8
Rural	1.72	1.54	89.4	37.6	54.9	55.2	31.3	1.5	97.2
Urban	1.30	0.23	18.0	13.1	59.3	43.7	32.1	4.1	91.8

Source: LCMS (CSO, 2016)

Moving to more affordable protein-rich foods could free up budgetary space at a household level and materially change how poverty is measured in Zambia. The Central Statistical Office (CSO) undertook research to determine the poverty line in the 2015 Living Conditions Monitoring Survey (LCMS) using a 'cost of basic needs' approach. This starts by determining the cost of a simple food basket that meets minimal nutritional requirements for a family of six. Table 1.4 is a slightly modified version of the CSO table appearing in the LCMS 2015 report. It shows the composition of the basic food basket together with corresponding costs per household per month in adult-equivalent terms. The 2015 food basket was valued at K152 per adult equivalent per month, the national extreme poverty line. The CSO estimates of minimum nutritional requirements suggest that about 47 per cent of the monetary value of the food basket should consist of protein-rich ASFs. Except for milk, all the ASFs chosen by CSO were the most expensive sources available in Zambia on a per unit basis, as shown in Figure 1.3. Substituting these with more affordable foods would mean important cost savings for households and would notably impact the measurement of food poverty in Zambia.

Table 1.4: Food basket for a family of six, Zambia, 2015

Consumption item	Month quantity	Unit price, 2015 (K)	Total price, 2015 (K)	Item cost (% of total cost)
Cooking oil (local 2.5ltr)	1	38	38	5.5
Dried beans (1kg)	2	13	26	3.8
Dried bream (1kg)	1	68	68	9.9
Dried kapenta (1kg)	2	104	208	30.2
Fresh milk (500ml)	4	5	20	2.9
Onion (1kg)	4	10	40	5.8
Shelled groundnuts (1kg)	3	13	39	5.7
Table salt (1kg)	1	5	5	0.7
Tomatoes (1kg)	4	5	20	2.9
White roller meal (25kg)	3.6	54	194.4	28.2
Vegetables (1kg)	7.5	4	30	4.4
Total cost			**688.4**	**100.0**
Notes:				
Adult-equivalent scale for family of six was:			4.52	
Food poverty line, 2015 (adult-equivalent household level, K):			152.3	
Item cost of all protein-rich ASFs combined:				46.8

Source: LCMS 2015

How can proteins be made more affordable?

Many factors drive household adoption and services (Sanni and Neureiter, 2018), which are fundamentally shaped by the culture and communities that these households operate within. These factors include:

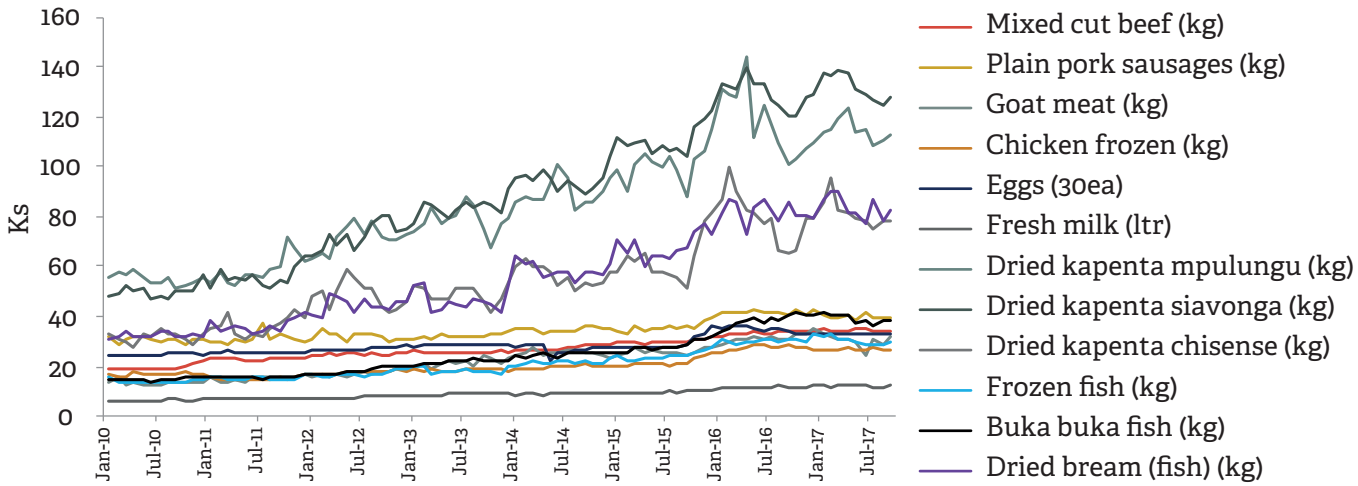
- awareness (knowing about a product or service);
- availability (having a reliable supply of a product or service);
- affordability (the ability to pay for a product or service);
- access (the ability to reach a product or service physically and culturally); and
- advantage (the upside from acquiring a product or service)

This report focuses on affordability (the ability to pay) and on what commercial players can do to enhance affordability from the supply side. The primary ways this can be achieved are lower prices and reduced costs of access – both of which are explored here briefly.

Retail prices

Retail prices are a key element of affordability, and they can be explored through the CSO, which publishes retail prices across ASFs. Figure 1.3 shows national-level retail prices for 12 ASFs, including 10 foods measured on a per kg basis, eggs measured per tray of 30 and fresh milk measured per litre. The unit prices reveal that wild-caught fish, dried kapenta (sardine-like fish) and dried bream were the most expensive ASFs at retail level in Zambia. These are out of the scope of this analysis as there is no instance of commercial production for these fish and the supply is thereby informal.

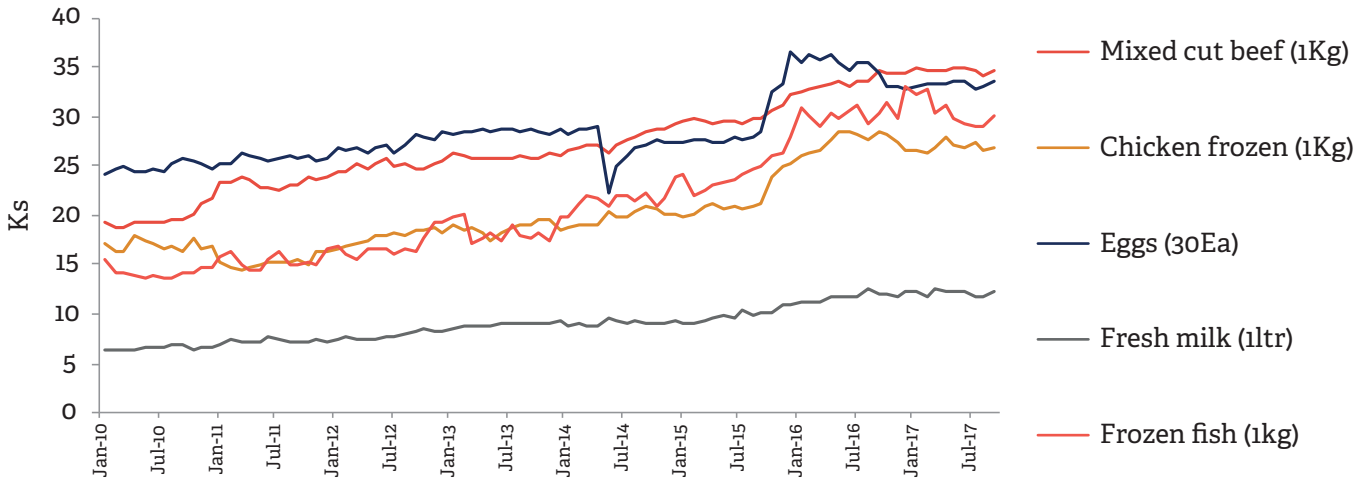
Figure 1.3: Average retail unit prices for selected animal source foods



Source: CSO, Zambia

The five food value chains selected for analysis in this study – chicken meat, eggs, milk, farmed fish and beef – are sources of the least expensive protein-rich ASFs. The retail unit prices of the five commodities are presented in Figure 1.4. In Zambia's case, of the five ASFs a litre of milk was the cheapest retail ASF, at around K12.3 per litre as of September 2017. On the other hand, mixed cut beef, at K34.6 per kg, was the most expensive. The protein content of each ASF should also be considered when identifying sources of low-cost protein. Milk for example has about 4 per cent protein content compared with 13 per cent for eggs, and 22 to 27 per cent for fish, chicken and beef as shown in Table 1.5.

Figure 1.4: Average retail unit prices for the five food value chains of study focus



Source: Central Bureau of Statistics, Zambia

The ultimate retail price of ASF critically depends on an activity that happens much further up the value change, during the process of feeding and ensuring high feed conversion ratios. The feed conversion ratio measures the efficiency with which an animal's stockfeed intake is converted into live weight of that animal. According to Arbor Acres (2011) "small changes in this ratio at any given feed price will have a substantial impact on financial margins" (p.1) and therefore on the final retail price of the food end products. Good feed management is critical for mitigating problems of low feed conversion ratio and ultimately high prices. Arbor Acres argues that the key to preventing feed conversion ratio problems is ensuring that good management practices are in place throughout the 'grow-out' period of an animal.

The divisibility of food products matters, particularly among low income households and people who often seek to smooth out spending by buying smaller quantities more frequently – even if marginally more expensive. For instance, eggs can be bought individually at K1.20 instead of per tray at the same price per egg. With each egg bought as a micro-unit, the total equivalent cost of a tray ends up at K36. This is K2.38 higher than the cost of one tray of eggs at a time, but low income households readily make the sacrifice because the divisibility allows them to spend a little cash at a time. Eggs are also popular in rural areas as they do not require a cold chain, which other more perishable animal proteins often do. The least expensive type of beef in Zambia is mixed cut beef – which is also very divisible.

If the purpose of food is to nourish, then the value of any food should be determined by its nutritional building-blocks like carbohydrates, protein, fat, vitamins and minerals. Table 1.5 shows the protein content of each type of ASF presented in Figure 1.4. Chicken meat has the highest followed by fish. Although beef is relatively expensive (Figure 1.4), its protein content is relatively high. Milk is the least costly product by weight but also has the lowest protein content.

Table 1.5: ASF protein content

Food item	Protein content in grams per 100g
1. Chicken (meat)	27
2. Fish (tilapia)	26
3. Beef (various cuts)*	22–26
4. Eggs	13
5. Milk	3.2–3.4
5.1. Yogurt (dairy product)	3.3–10
5.2. Cheese (dairy product)	20–38

Notes:
* "Mixed cut" beef not included because the cut does not exist in the US Department of Agriculture classification

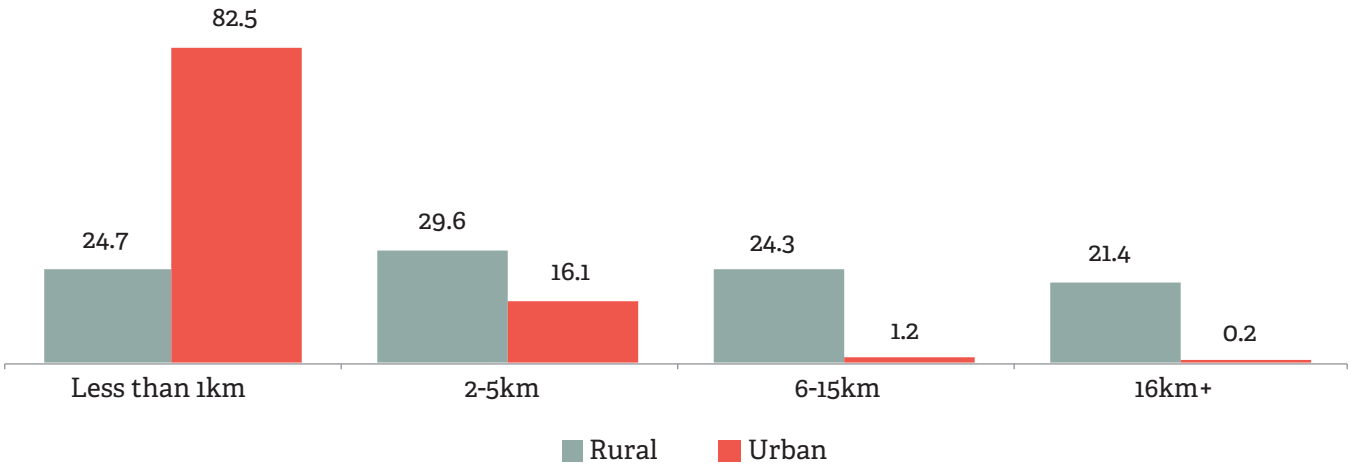
Source: US Department of Agriculture (n.d.)

Costs of access

Physical access to food, particularly in terms of distance to food markets, can be a significant barrier that prevents households from getting it. Lowering the cost of access to food is critical for making it more affordable. Lowering access costs can be done directly through reducing the distance to market, for instance, by increasing the number and density of outlets in an area – meaning they are closer to households on average. It can be done (not necessarily by the private sector) by helping households to travel further at lower cost (financial, time etc.). Examples of this could include: (1) establishing mobile market sub-units that increase the reach of physically constrained food markets; (2) providing households far away from food markets with (monetary or in-kind) transportation subsidies; and (3) enhancing the state of the public transport infrastructure thereby lowering the cost of travelling. The list is by no means exhaustive but aims to show some interventions for reducing the costs of access – which are central to food affordability.

In Zambia, rural populations face relatively higher cost of access constraints in terms of distances to food markets. While the vast majority of urban resident households (82.5%) were located less than 1km from their nearest food market, only 24.7 per cent of rural households were in a similar situation. The largest proportion of households (29.6%) were about 2–5km away from their nearest food market. One in four rural families was between 6–15km from the nearest food market and one in five households was 16km or more away. These proximity-to-market issues are partially mitigated by rural households consuming a significant amount of food that they have produced themselves (see Table 1.2), and so they do not rely solely on (the nearest) conventional food markets to source their foods.

Figure 1.5: Percentage distribution of households by proximity to food market



Source: LCMS, 2015

Addressing the physical barriers of accessing food markets will over-proportionately benefit people from rural areas – traditionally underserved by large, formal retailers. For the families in the categories of 6–15km and 16km or more from food markets, the cost of access was inherently much higher than households closer to the market. It is therefore not surprising that, as reported in the LCMS 2015 report, the proportion of households with knowledge of the nearest food market to them was significantly lower in rural areas (at 78% of all rural households) compared with urban households (97%). Proximity to markets was clearly a key determinant of knowledge of and thus access to food markets.

The rest of this report is structured as follows: Section 2 is a demand-side analysis of the importance of protein-rich foods to consumers; Section 3 considers the supply side of selected protein-rich ASF value chains; and Section 4 closes the paper with a list 'actionable propositions'. These are potential interventions that commercial players could take up at all levels of the value chain (either as individual companies or on an industry-wide basis); making ASFs more affordable and accessible for low income and underserved population groups.

> "The large size of rural food markets underscores the importance of distribution strategies that can efficiently reach rural base of pyramid (BOP) households"
>
> **The Next 4 Billion: Market Size and Business Strategy the Base of the Pyramid**
>
> **International Finance Corporation (IFC), 2007**

2. Listening to customers: what can we learn from buying behaviours?

Summary

- Low income consumers spend less per household, but still account for a large proportion (43%) of the overall market. These households are therefore harder to serve (given lower household income, less frequent consumption of meat and greater geographical dispersion), but nonetheless present a very compelling commercial opportunity. This will be driven by their high overall volumes – on the condition that businesses can reach them through driving down production and distribution costs.
- There is also a large opportunity for commercial producers and distributors to viably serve a market segment of households traditionally underserved by the industry (mainly rural households, at all income levels). A significant share of these households perceive an undersupply of protein-rich foods – specifically meat and poultry (24% of households surveyed said they had insufficient supply to meet their needs) and fish (16% of households) – even while spending comparable amounts on these foods – K46 (vs K69) a week on animal proteins. In particular, enhancing the supply of affordable, quality fish appears to present the greatest single opportunity for reaching these households.
- Typically underserved households also appear to see value in commercial retailers, since such households go further afield at least once a month to visit such large, commercial retailers. This signals significant latent demand and suggests that quality and product availability look to be drivers of demand as well as price.

This chapter summarises the key messages from low income and underserved households in Zambia about how commercial players can enhance the supply of affordable protein-rich foods to them. The major protein-rich foods investigated are beef, chicken, eggs, dairy, fish and pork, given their per-unit affordability and prevalence in the Zambian market. To answer these objectives, a comparative analysis is made between different customers groups focusing on spending on protein-rich foods.

Methodology

Data source

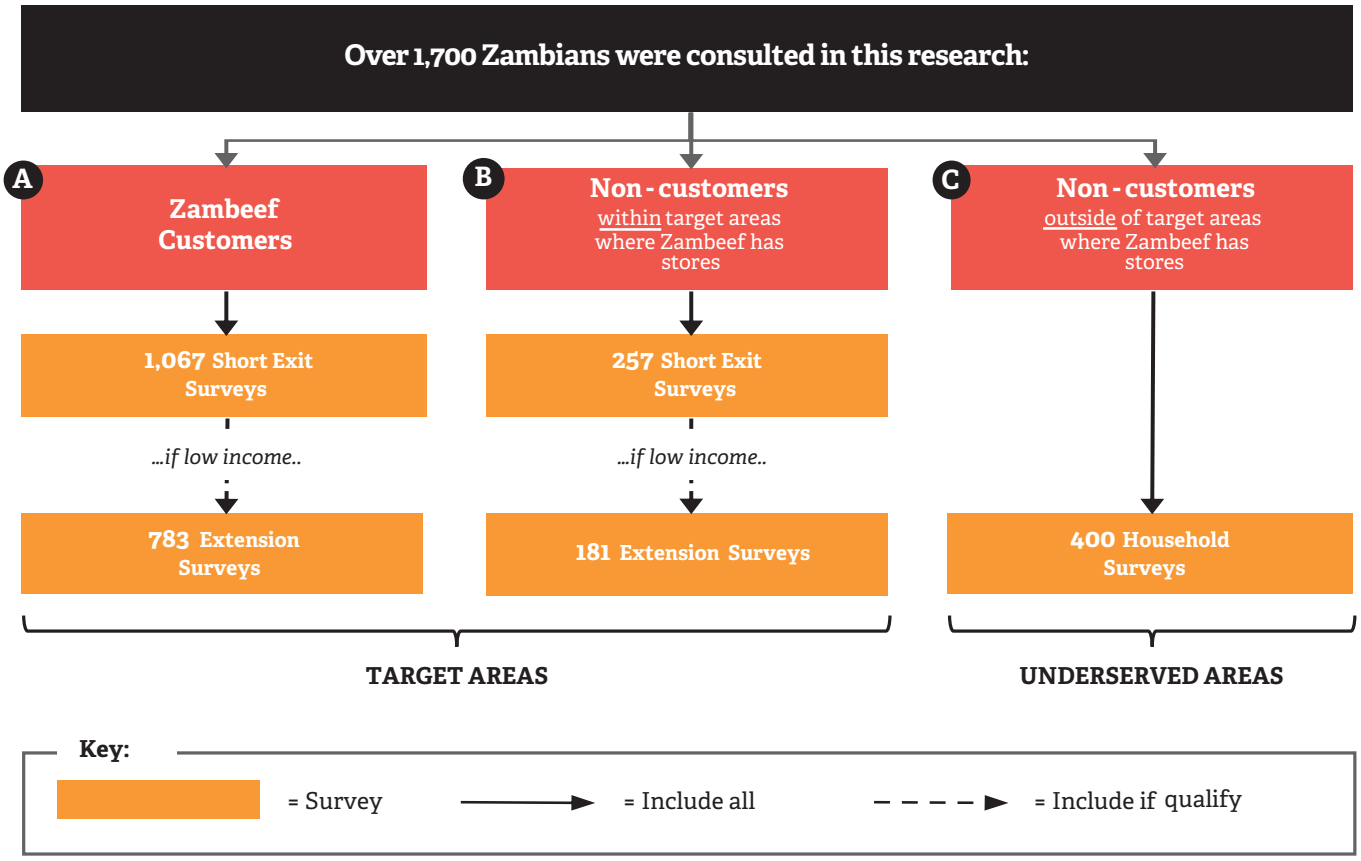
CDC Group plc[3] partnered with Zambeef Products plc[4] to better understand the affordability of protein-rich foods in Zambia. In October 2017, a Dalberg Research team (formerly Research Solutions Africa) conducted household and customer surveys across Zambia.[5] The surveys, consisting of face-to-face interviews with 1,724 Zambian adults (aged 18 years or older), are a key data source for this study. The sample was made up of the three sub-sample groups shown in Figure 2.1.

3 CDC Group plc is the UK development finance institution wholly owned by the UK Department for International Development. Since 2016, CDC Group has been a shareholder in publicly listed Zambeef Products plc.

4 Zambeef is the largest beef producer in Zambia. The company also provides feedlot services, and manufactures milk, chicken, eggs, leather and shoes. Zambeef's vision is to become one of the most accessible and affordable quality protein providers in the Southern Africa region.

5 Commercially sensitive data from the Dalberg Survey have not been shared in this report. In line with CDC's commitment to transparency and bolstering the knowledge of the broader private sector, findings from this survey have been used to the extent that they help to better answer the question of how commercial producers and distributors can, and do, enhance the affordability of protein-rich foods for low-income and underserved households.

Figure 2.1: Study sub-sample groups



In sub-sample A, 23 Zambeef stores were purposively sampled to give robust representation across all 10 Zambian provinces, and 1,067 customers were then randomly chosen on exit from stores. In sub-sample B, a reference group of 257 respondents were randomly surveyed in 'interception' interviews on the way out of local alternative butcheries or markets – these surveys took place across eight different sites that spanned Lusaka and the Copperbelt. In sub-sample C, 400 households were randomly surveyed across 20 randomly chosen underserved districts – spanning 9 of Zambia's provinces (20 surveys were targeted from a randomly selected rural ward in each of the 20 districts). Underserved districts are those that are likely to be less well served by large formal food retailers than others. To isolate this group: districts served by the biggest large, formal food retailers were excluded, and districts with a poverty headcount of less than 70 per cent in the 2010 LCMS (noting that district-level data was not available for the 2015 LCMS, and little change relative the positions of districts was expected) were excluded as a second criteria.

Data analysis

Self-reported spending and buying behaviour were used to draw insights on how commercial producers and distributors can make protein-rich foods more affordable. To gain deeper insights into consumer behaviour, pairwise correlations and logistic regression analysis were also employed. The analysis correlated major consumer attributes with expenditure by low income households and weekly expenditure by underserved households. The major consumer attributes included: employment status, access to refrigeration, distance to the store, sources of protein foods, purchases from commercial outlets, shopping and meat-eating frequency, own production of ASFs and perceptions of ASF affordability, availability and quality.

This report separately looks at the key takeaways for two groups included in the survey – low income and underserved households.

Low income

Predominantly urban households and consumers were surveyed. This section summarises key messages from those in the **bottom 40%** of the income distribution – many of whom are currently within the geographical footprint of commercial players.

Underserved

Entirely rural households were also targeted **across the income distribution.** This section also summarises key messages from those typically not served by commercial players – who are currently beyond the geographical footprint of commercial players.

Key takeaways from low-income consumers

Low income consumers present a substantial commercial opportunity (43% of the market potential) if businesses can reach them at scale. Average household spending on animal proteins per shopping trip was K58 among low income consumers (median K28) and K210 among high income consumers (median K40). Despite lower individual spending, low income households dominate the buying population in this survey (noting potential biases driven by under-reporting of income and self-selection). For every high income household interviewed in the survey there were three or four low income households. The market importance of low income households is reflected in their 43 per cent share of total expenditures on ASFs. Individual households may spend only a little at a time but cumulatively their spending is significant. These households may be harder to serve due to lower disposable income, less frequent consumption of meat and greater geographical dispersion – but they present a compelling opportunity for commercial players if they can be reached. Commercial producers and distributors have the opportunity to better serve them through driving down production and distribution costs – passing at least some of these savings through to consumers.

Low income consumers articulate overall preferences (and willingness to pay) for dairy, beef, chicken and fish. The composition of shopping baskets for low income consumers varies widely – both in terms of the (a) amount spent on each product, and (b) the frequency of purchasing each product. The amount spent on each product per purchase was beef (K50), chicken (K40), dairy (K36), pork (K35), eggs (K28), fish (K15) and dairy products (K12). But the frequency of purchasing a specific product was led by dairy products (21%), followed by chicken (16%), fish (15%), beef (13%), pork (5%) and eggs (4%). Considering both frequency and value of purchasing by low income consumers, the greatest opportunities appear to be for dairy, beef, chicken and fish.

Enhancing access to refrigeration and modern electricity to low income households could serve to increase their consumption of animal proteins by freeing them up to make the most economical purchasing decisions. Low income households with access to electricity for cooking are 10 per cent more likely to spend above the median on protein-rich foods. Access to refrigeration (which only 37% of low income consumers had) also results in 10 per cent more likelihood to spend above the median on protein-rich foods. This may well be because consumers who have access to refrigeration are able to buy in bulk – taking fewer, but higher value, shopping trips – though there is not sufficient data to prove this.

Increasing the number of well-placed commercial outlets serving low income consumers directly, or indirectly through supplying to local markets, could enhance the consumption of protein-rich foods. Low income consumers typically travel on foot (and are less able to refrigerate food), so make more frequent, lower value journeys to buy food. Increasing the number of stores within the reach of low income consumers could drive down their costs of accessing protein-rich foods. Hub and spoke models such as large outlets which sell protein-rich foods wholesale to local markets and suppliers also present an opportunity to enhance the reach of protein-rich foods to low income groups with a limited radius of travel to buy food. Zambeef is an example of where this can be achieved successfully with its outlets tending to reach a broader number of low income consumers given its store positioning in lower income areas than many commercial competitors (often located in major shopping districts) and the introduction of 'wholesale' stores.

Key takeaways from underserved households

Households typically underserved by commercial producers and distributors spend less than 'well-served' households on protein-rich foods, largely driven by geography. Among underserved households the average weekly expenditure on animal proteins is K46 (median K39) while among well-served households it is K69 (median K55). Underserved households spend significantly less on meat, poultry, eggs, dairy and fish than well-served households on average. This is driven by higher unemployment (lower income), less access to refrigeration (only 22% with access) and poor availability of animal proteins. Nevertheless, it is differences between, not within, geographies that lead to this divergence – that is underserved households are concentrated in poorer provinces (where households generally spend less on animal proteins). At a province level, weekly expenditure on animal proteins is not significantly different between underserved districts and well-served districts, except for Eastern province. There is one anomaly – Shiwangandu is the only 'underserved' district that had weekly expenditure on animal proteins higher than that of Mpika, a well-served district in Muchinga – but this difference is not statistically significant (see Annex 1, Table A.6).

Affordability, quality and availability all drive preferences for different animal proteins – principally fish, meat and poultry – with cultural factors likely playing a role. Food groups perceived to be more affordable, of good quality and available in sufficient quantities are purchased more frequently than others. For underserved households this principally means fish (37% of weekly animal protein expenditure) and meat and poultry (46%), with eggs and dairy products accounting for much less of the overall household budget. The strength of these preferences varies by region. Districts in which fish dominates include Chililabombwe (38%), Luangwa (46%), Mwense (41%), Mufumbwe (54%), and Senanga (48%). In each of these districts there are large rivers that may shape cultural preferences towards fish. The Kafue River flows close to Chililabombwe. Luangwa River is in Luangwa, Luapula River in Mwense, Kabompo in Mufumbwe and Zambezi River in Senanga. Spending on fish also increases for households that produce their own food, since fish is rarely own-produced on a small-scale – meaning it needs to be bought. Districts in which meat and poultry dominate include Chibombo (37%), Shiwangandu (46%), Mbala (43%) and Kalomo (54%). These districts all have considerable livestock farming, which may similarly shape cultural preferences towards meat and poultry.

Serving underserved households indirectly through supplying to local markets could enhance the consumption of protein-rich foods. Weekly spending on animal proteins increases with purchases made from local markets and commercial outlets. Underserved consumers buying from commercial outlets are 13 per cent more likely to be above median expenditure than households typically well-served by commercial producers and distributors. People who buy from local markets are 9 per cent more likely to be above median expenditure than their counterparts.

The ratio of underserved consumers shopping at commercial outlets to those buying from local markets is about one to four, meaning local markets offer a wider consumer base in underserved locations. Commercial distributors may have an opportunity to wholesale supply animal proteins to traders in local markets. If competitively priced, this could help to address the challenges of higher costs of access in underserved areas – where 79 per cent of households travel on foot to purchase food.

3. Mapping the supply side: where are the opportunities along the value chain?

Summary

- Across multiple value chains similar core themes reoccur including:
  - Opportunities to aggregate small or medium-sized enterprises (SMEs) (through cooperatives, shared collection centres etc.) to which inputs, extension services and off-takers could focus.
  - Opportunities to target private investment at bottlenecks in value chains (eg aquaculture hatcheries or processors) to drive down production costs.
  - Opportunities to support SMEs in the value chain with more robust supply-chain finance, allowing them to accrue the benefits of greater scale and drive down production costs.

In this section, we consider the supply side of enhancing the affordability of five animal proteins (poultry meat, eggs, dairy, beef and fish). We do so by stepping through the value chains of each protein, using a mix of key informant interviews with industry players and literature reviews to build out value chains that have previously been systematically mapped (eg poultry and fish), and mapping them out anew based on literatures and interviews where they have not (eg dairy and beef). This value chain mapping largely draws insights and evidence from McKee (2017), World Bank (2017), Sutton and Langmead (2013), selected working papers from Indaba Agricultural Policy Research Institute and any other relevant literature. The main commercially produced, protein-based food value chains considered in the descriptive analysis are:[6]

- poultry, covering broilers for *chicken meat* and layers for *eggs*;
- dairy, covering *milk* (and to a limited extent other milk-based products);
- beef; and
- fish, covering farmed *fish* only (excluding kapenta and other capture fisheries).

Summary statistical tables capturing estimated production and net domestic consumption amounts of chicken meat, eggs and fish are presented in turn in Tables 3.1, 3.2 and 3.3, respectively. Summary statistics for beef and milk could not be produced because of limited data on their domestic production.

6 The value chains for plant-based (legume) protein foods and protein-rich ASFs other than those already listed are not considered in the analysis, to keep it tractable and given the non-commercial nature of some of them. The excluded products also include culturally popular but non-commercial unusual protein-foods (insects: Finkubala, Inswa, Mafulufute, Shongonono; fish: Nkala, Magande, Mibondo etc.; marsupials: Mbeba etc.).

Table 3.1: Chicken production and consumption in Zambia

	2013	2014	2015	2016	2017
	(metric tonnes per year)				
Commercial/large-scale farmers (20,001–100,000 birds per cycle)	24,493	26,617	28,410	27,838	30,057
Outgrower[8] farmers (10,001–20,000)	12,246	13,309	14,205	13,919	15,029
Small-scale farmers (1–10,000)	85,724	93,160	99,436	97,432	105,201
Chicken imports	1,859	4,387	7,460	11,779	19,596
Chicken exports (15% PAZ estimate)	18,369	19,963	21,308	20,878	22,543
Total chicken consumption (less exports)	93,706	104,201	113,998	116,170	132,311

Source: constructed from data provided by Poultry Association of Zambia (PAZ) and Common Market for Eastern and Southern Africa (COMESA)

Table 3.2: Egg production and consumption in Zambia

	2014	2015	2016	2017
	(metric tonnes per year)			
Commercial/large-scale farmers	34,730	37,500	40,135	39,486
Small-scale farmers	14,884	16,071	17,201	16,923
Egg exports	17,365	18,750	20,068	19,743
Total egg consumption (less exports)	32,249	34,822	37,268	36,666

Notes: Egg import statistics not included because the net-weight data from the source had low, seemingly unreliable statistics on eggs.
Source: constructed from data provided by PAZ and COMESA

Table 3.3: Fish production and consumption in Zambia

	2012	2013	2014	2015	2016
	(metric tonnes per year)				
Farmed (aquaculture) fish	12,500	21,200	19,700	22,800	30,800
Capture fish	75,100	74,400	80,500	81,000	81,300
Fish imports	17,906	49,119	50,621	78,048	126,899
Fish exports	52	142	131	340	203
Total fish consumption (less exports)	105,455	144,578	150,690	181,508	238,796

Source: constructed from Indaba Agricultural Policy Research Institute, African Development Bank and COMESA data

7 Outgrowers are farmers commissioned, financed (or partially financed) and technically supported by commercial/large-scale farmers to exclusively produce for supply to the commercial/large-scale farmers, towards augmenting their supply. They are therefore inherently integrated into the commercial/large-scale farmers' supply chain.

Poultry value chain

Summary

- There are opportunities to enhance supply-chain finance for input markets, either by formalising credit between hatcheries and poultry farmers or between point-of-lay producers and poultry farmers, to help drive down production costs.
- Public policy decisions (eg import/export restrictions) directly influence the ability of commercial players to drive down production costs.
- There may be opportunities for commercial players to work more closely with cooperatives of smallholder and emergent medium-scale farmers – providing appropriate modern infrastructure and off-take; though challenges with different models should be well noted (TechnoServe, 2011).
- There is also an opportunity to further the already existing product variety for poultry meat.

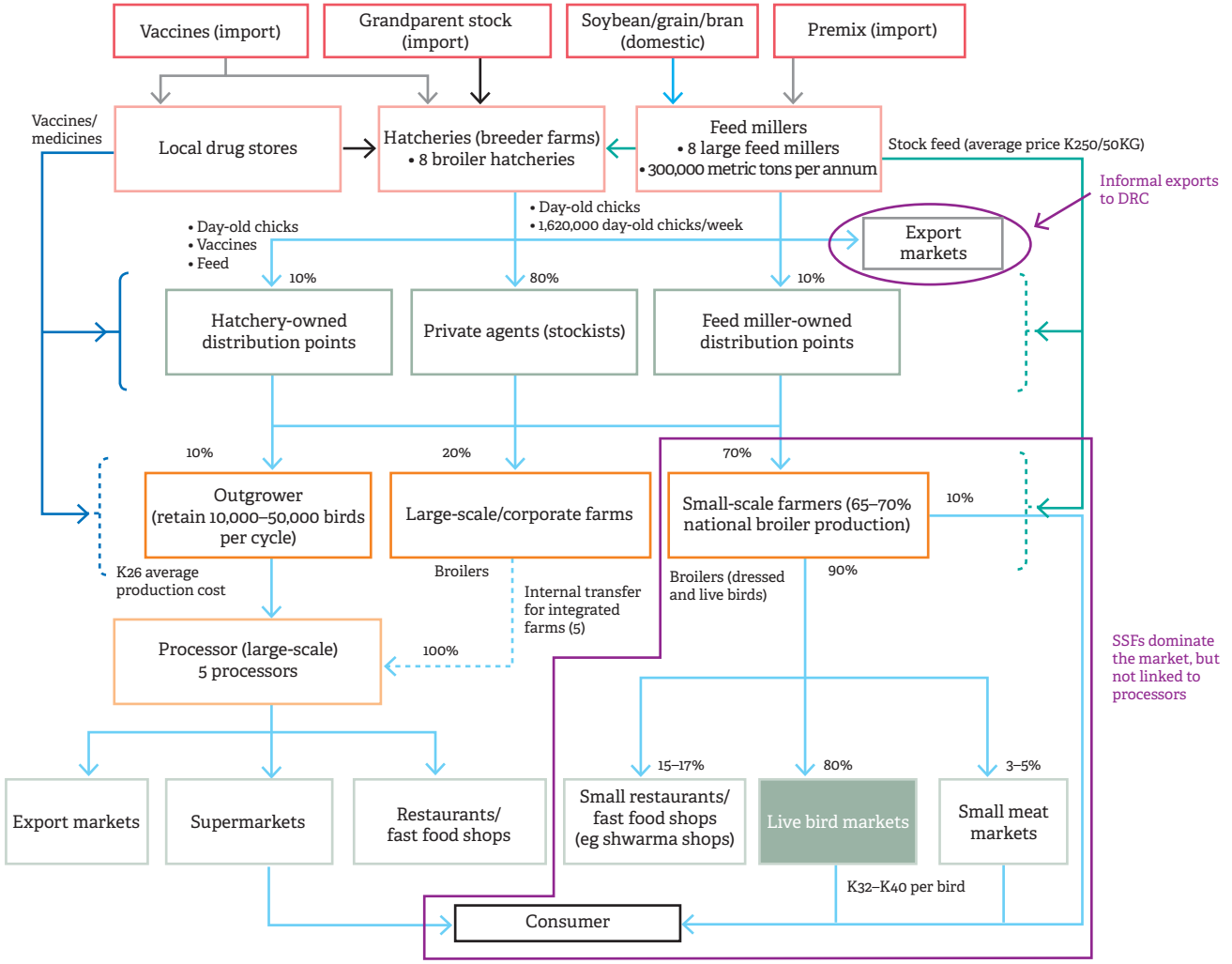
Value chain overview

Some international observers and many local industry insiders argue that after South Africa and along with Kenya, Zambia has one of the most developed, integrated and competitive poultry sectors in sub-Saharan Africa. McKee (2017) highlights that in part this is because from around 2005 to 2014, before the sharp Kwacha devaluation and general economic slowdown of 2015–16, Zambia saw rapid expansion in the number and average size of commercial layer and broiler farms. The entry of new input suppliers, producers, processors and distributors has been positive for competition and has led to lower prices.

The poultry sector consists of two types of production: *broilers*, which are raised for *chicken meat*; and *layers*, which are primarily used to produce *eggs* (although spent hens are sold for their meat at the end of their productive cycles usually 12 to 18 months). Zambia experienced a 4.8 per cent reduction in commercial broiler production from 78.9 million birds in 2015 to 75.2 million in 2016, and a 14.6 per cent fall in commercial pullet production for use in layer farms from 2.3 million birds in 2015 to 2.0 million in 2016. Out of the total commercial production of broilers, 87 per cent went into the domestic market in 2016 compared with 90 per cent in 2015 while 6.9 per cent were exported mostly to the neighbouring Katanga province of DRC. Due to excess production 6.3 per cent were culled at the day-old stage (PAZ, 2017).

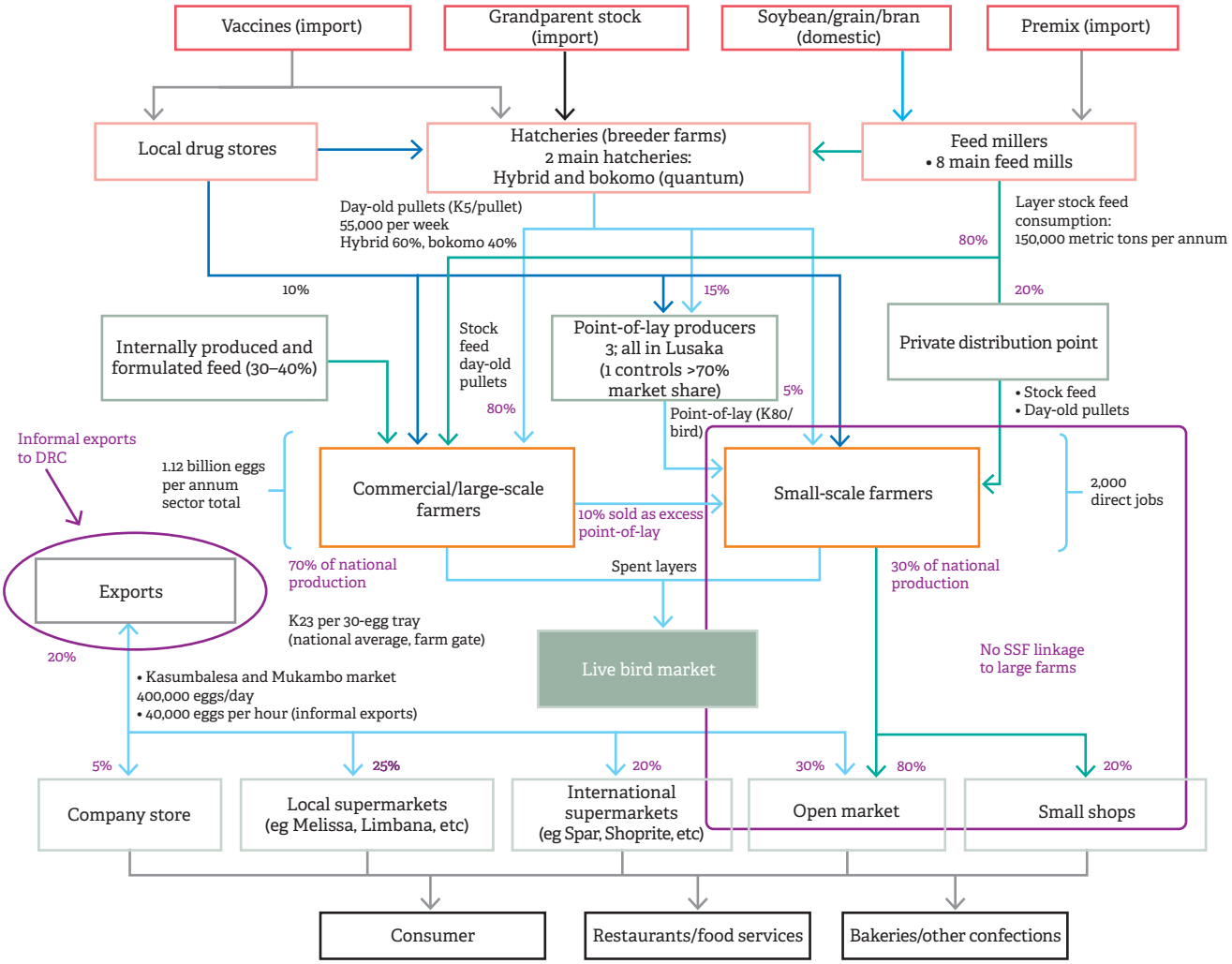
Various authors have described the broiler and layer value chains in Zambia. The most systematic and comprehensive recent report was by the World Bank in 2017. Figures 3.1 and 3.2 present the broiler and layer value chains.

Figure 3.1: Broiler value chain in Zambia



Source: Global Development Solutions, LLC and PAZ as in World Bank (2017)

Figure 3.2: Layer value chain, Zambia



Source: Global Development Solutions, LLC and PAZ as in World Bank (2017)

Based on a mapping and analysis of the main actors in each of the two sub-sectors in the poultry value chain, this report identifies potential opportunities in the section that follows.

Input suppliers in the poultry value chain

There are two main types of input suppliers: hatcheries and feed mills.

Hatcheries produce and supply day-old chicks World Bank (2017) and Poultry Association of Zambia (PAZ) (2017) information reveal that in 2017 ten hatcheries were operating in Zambia, eight of which produced broilers and two of which mainly produced day-old layer chicks and point-of-lay pullets[8] with small outputs of broiler day-old chicks. Some key findings from the mapping and key informant interview include:

- **The hatcheries' supply of day-old chicks was adequate, and delivery was timely reflecting the high level of development of the poultry industry in Zambia.** However, lower poultry demand due to the rise in feed prices coupled with increased production from large new hatcheries resulted in smaller producers having to cull a significant amount of their day-old-chicks. Farmers switching to lower-cost suppliers resulted in some of the older hatcheries recording drops in day-old chicks sales ranging from 5 to 26 per cent.

8 A point-of-lay pullet is a young hybrid layer chicken that has just reached the age of laying eggs as a hen. The average age for layers to reach point of lay and come into normal lay is around 22/24 weeks, although this depends on the breed, the time of year and, in some cases, how the birds were reared.

- **By mid-2018 the day-old chicks situation had changed with a sharp increase in demand for day-old chicks that could not be met by domestic hatchery output.** Day-old chicks and poultry inputs including feed are typically distributed through private agents. A handful of large hatchery operators also sell day-old chicks through their inhouse outlets. The day-old chick sector operates with various models for supply and distribution to poultry farmers, including full payment in advance, cash-on-delivery and partial layby schemes.[9] Hatcheries typically supply large poultry farmers. Some hatcheries also engage with smaller scale poultry farmers who they regularly supply, providing inputs upfront without payment, allowing the farmers to raise the birds, and off-taking the output at the end with a payment to the farmer net of input costs. All the hatcheries reportedly import vaccines, other veterinary supplies and the grandparent stock for breeding.

- **Large players, when acting together, have substantial impact on market prices.** After a four-year investigation in February and March 2018, the Board of Commissioners of the Competition and Consumer Protection Commission fined four Lusaka-based hatcheries (Hybrid Poultry Farm Zambia Limited, Ross Breeders Zambia Limited, Quantum Foods Zambia Limited and Tiger Chicks) 7 per cent of their annual turnover for practices that the Commission determined to amount to fixing trade conditions and setting production quotas through long-running cartel structures contrary to the provisions of the Competition and Consumer Protection Act, No. 24 of 2010.[10]

- **SMEs play a significant role in the poultry value chain in Zambia, accounting for an estimated 70 and 30 per cent respectively of broiler and egg production** (PAZ interview; World Bank, 2017). For layers, day-old chicks need to be reared for six months to reach point of lay. Because of this, small farmers typically do not purchase day-old chicks from the two hatcheries producing layers. Instead, they rely on point-of-lay producers to bear the costs and risks of raising the chicks to point-of-lay stage. As of 2017 there were three point-of-lay producers in Zambia, all located in Lusaka.

Feed mills produce and distribute poultry feed in the same way for broilers and layers. World Bank (2017) named eight large feed millers in Zambia (though there are now believed to be ten), with their combined total annual production of feed estimated at 300,000 tonnes in 2017. Industry sources report that all of these companies (with the exception of two specialised fish feed producers) produce poultry feed, which is the most important component of their output. Independent feed millers depend on a widespread network of independent stockists and sales outlets nationwide. The feed sector is well organised, competitive and efficient. Nevertheless, stockfeed prices in Zambia are relatively high by southern African regional standards.

In Kwacha terms feed prices soared during the 2015–16 period, reportedly increasing by 72 per cent on average for broiler feeds and 56 per cent on average for layer feeds (PAZ, 2017). This was on account of the sharp Kwacha devaluation, limited electricity during a period of planned power cuts known as 'load-shedding', general increases in the prices of inputs particularly maize and soya beans, and persistent high interest rates on working capital loans. Stockfeed production relies on inputs such as soybean meal and maize that come from local producers. It also relies on imported inputs of animal feed ingredients (such as vitamin and mineral premixes with antibiotics (PAZ, 2017).

9 Partial layby is where the farmer makes a down payment, which is a percentage of the total consignment costs and thereafter makes agreed periodic layby to cover the outstanding balance.

10 The Commission also ordered the four to terminate their agreement, the so-called 'Chick Order Policy' established through PAZ, and to independently set lead times for pre-booking that are viable and auditable. The policy had enabled hatcheries to only set eggs according to demand, requiring poultry farmers to book four weeks in advance for day-old chicks. PAZ defended the policy, arguing it was meant to create a common, predictable standard for the industry to stem losses that had emerged among the hatcheries due to an increasing frequency of non-off-take of day-old chicks by farmers. A result has been the disbanding of PAZ, one of whose primary functions had been operating the scheme. At the time of this report the outcome of industry legal challenges to the order and creation of a new umbrella organisation to represent the interests of Zambia's poultry industry remained unclear.

For instance, the imposition of a 10 per cent export duty on maize exports and a maize export ban, both introduced in late 2016, to some extent helped reduce the maize export propensity and helped lower stockfeed prices. In 2017, stockfeed prices started to decline. Average stockfeed prices in January to June 2017 were 6 to 12 per cent lower than the average prices recorded during January 2015 to December 2016 (Table 3.4)

Table 3.4: Animal feed prices per 50kg bag

	Average January 2015 to December 2016 (K)	Average January to June 17 (K)	% change
Broiler starter	257	230	-10
Broiler grower	247	223	-9
Broiler finisher	238	217	-9
Pullet starter	212	191	-12
Pullet grower	197	186	-6
Pullet developer	192	177	-7
Layer mash	203	183	-10

Source: PAZ (2017)

Following investment in maize and soybean production, output has risen. Maize production in 2016–17 was 3.61 million tonnes compared with 2.87 million tonnes in 2015–16, a 25 per cent increase. Industry requirements of maize for feed production increased 5 per cent annually between 2015/16 and 2017/18 (based on requirements estimated by major stockfeed producers at the start of each season) (Table 3.5). Soybean production increased by 31 per cent from 267,490 tonnes in 2015–16 to 351,416 tonnes in 2016–17. Cultivated areas of the two crops increased by 20 per cent for maize and 59 per cent for soybeans from year to year. However, because of the steep depreciation of the Kwacha from 2015 to 2017, 2016–17 poultry feed use decreased from the previous year. The exogenous shock from the Kwacha devaluation ultimately caused about a 20 per cent increase in production costs as measured in Kwacha, since maize and soybean prices are US dollar based. Despite this, poultry feed supply remained stable reflecting a robust feed sector.

Table 3.5: Estimated maize output requirements as inputs for selected activities

Maize requirements	2015/16	2016/17	% change (2015/16–2016/17)	2017/18	% change (2016/17–2017/18)
Animal feed[1]	245,630	257,912	5	270,807	5
Breweries[2]	110,000	115,500	5	121,275	5
Losses[3]	130,911	143,653	10	180,327	26
Structural cross-border trade[4]	200,000	200,000	0	200,000	0
Food Reserve Agency export commitments	358,417	… [export ban]	…	n.a	…

Notes
1. Estimated requirements by major stock feed producers.
2. Estimated requirements by industrial breweries.
3. Post-harvest losses are estimated at 5% for grains in line with estimates from other Southern African Development Community countries.
4. Structural exports represent cross-border trade, mostly to the DRC, that occurs on a continuing basis and that is likely to occur during the marketing season. It does not include Formal trade.
"n.a" = (data) not available
"…" = not applicable

Source: PAZ (2017)

Most livestock feed in Zambia is from 50 to 70 per cent maize. There is therefore a positive impact from the long-standing government maize subsidy programme through procurement by the Food Reserve Agency (and the below cost, quota-based allocations to maize mills for maize meal production. The poultry industry enjoys positive spillover effects since direct and indirect subsidies of maize help to keep maize prices and therefore animal feed prices artificially low. Restrictions on maize exports also serve to keep domestic prices artificially low. Some large feed millers and several soybean crushing plants in Zambia offer commercial farmers US dollar-denominated contracts with fixed prices and quantities negotiated in advance of the season. This was part of an arrangement to institute a policy measure restricting the amount of pre-mixed livestock feed that can be imported by the feed milling companies thereby protecting the soybean farmers' market, but such arrangements lock both sides into positions of high exposure to foreign exchange risk.

Production: rearing broilers and producing eggs

Zambia's broiler sector is made up of nearly 35,000 smallholder farms and over 180 large commercial broiler farms; smallholders have about 65 per cent market and large commercial producers about 35 per cent (PAZ, 2017). Large commercial operations are able to reduce deaths and improve yield, quality and speed of bird maturity (for example by optimising lighting). PAZ estimates an average broiler of 1.2kg has a variable cost of K23 from day-old-chick purchase to selling the bird at the farm gate, equivalent to a cost of K19.2 per kg. Feed is by far the biggest cost component at about K13 to K15 to raise a 1.2kg bird. From 57 to 65 per cent of the total production cost, equivalent to K10.8–12.5 per kg, is related to feed. The difference between total production costs per bird of K19.2 per kg and the average retail price of K26.8 per kg is K7.7 per kg and covers slaughtering and packaging, distribution, producer margins and retail mark-up.

Smallholder farmers often make use of traditional methods needing little technology and small capital outlays. Rearing cycles are not very predictable and per farmer yields are low due to high mortality. Feeding practices vary, and birds take longer to reach the target weight at maturity. Unit production costs of smallholders are difficult to establish. Small-scale and traditional broiler farms mainly deliver live birds to local markets. These farmers typically have deeper reach into rural populations typically underserved by large, formal commercial players.

In contrast to the broiler value chain, the production of eggs through the layer value chain is highly concentrated among a limited number of large farms that make up about 70 per cent of national egg production. SME operators with a maximum of 20,000 hens and an average of less than 10,000 hens account for the remaining 30 per cent. The level of concentration is such that one large producer in Copperbelt province with up to 600,000 hens accounts for about a fifth of the country's entire egg output.

Commercial pullet production fell by 14.6 per cent from 2.3 million birds in 2015 to 2.0 million in 2016. As a result, overall egg production dropped by 26 per cent in 2016. In January 2016, 92.7 million eggs were produced, but by December monthly production had fallen to 59.7 million eggs. The slump in production was related to a 72 per cent increase in poultry feed prices. Egg prices rose by 22 per cent, from an annual average of K29 per tray (30 eggs) in 2015 to one of K35 per tray in 2016 (see also Figure 3.2). Nonetheless from 2015 to 2016 layer farmer profit margins declined by 48 per cent (PAZ, 2017 and PAZ interview).

The egg production decline did not translate into an equivalent drop in Zambian egg consumption since up to 30 per cent of national egg production until then had been exported to Katanga province in DRC, which is adjacent to Copperbelt province. A 140,000-hen layer farm was established in Lubumbashi, DRC in 2016 and this, coupled with the doubling of capacity of an existing layer farm to 90,000 hens, reduced import demand in Katanga by a third to a half. This forced Zambian layer farms with a high proportion of exports to refocus on the domestic market. In some months in 2017, wholesale egg prices dipped below production cost levels (PAZ, 2017 and PAZ interview).

Processing and distribution

The processing and distribution stages of the poultry value chain are handled by the large integrated poultry producers. There are few or no independent medium or large-scale commercial processors or off-takers. For broilers linkages between large commercial production and slaughtering, packaging and freezing or chilling is strong. On the other hand, there are hardly any links between small-scale farming and commercial processing. Aside from scale the challenge is smallholders are often using traditional production systems since they cannot afford to invest in the latest technology. Around 80 per cent of small-scale production went to local markets, including the supply of live birds in the broiler sector. In fact, the target markets for small-scale broiler farmers are almost exclusively live bird markets (World Bank, 2017).

Large producers apply optimised production models with integrated processing. They butcher birds at the right age and sell frozen meat to supermarkets and other formal retail outlets. This requires quality feed, well-built chicken sheds, abattoirs, packing houses with flash freezers and purchase agreements with anchor buyers. Such supply-side requirements are out of reach of smallholders and most medium-sized operations.

Large commercial producers can turn over 25,000 or more birds per cycle of 32 to 35 days. They are well-financed and able to work with tight profit margins. As such they do not compete in the same distribution channels as SMEs (see Figure 3.2). Large commercial farms also tap into export markets through informal trade with the DRC and Angola, targeting higher income urban consumers.

Potential opportunities

- **Local supply of vaccines and veterinary inputs:** While the supply of day-old chicks was adequate, and delivery was timely, it could be asked whether local supply of vaccines and other veterinary inputs and grandparent stocks might help to lower input costs. Further public sector-led research and development through institutions like the Central Veterinary Research Institute could help to establish the feasibility and cost-effectiveness of establishing local veterinary input suppliers.
- **Supply chain finance interventions:**
  - The prevalence of arrangements described previously (eg where some hatcheries enter into off-take arrangements with the broiler poultry farmers they regularly supply, providing inputs upfront without payment, allowing the farmers to raise the birds, and off-taking the output at the end with a payment to the farmer net of input costs), suggests there is scope to improve the cash-flow, productivity and turnover of actors at this stage of the value chain by establishing trade credit facilities, credit guarantee schemes and other financial arrangements.
  - Small-scale farmers could opt to raise day-old chicks to pullets at point of lay to reduce costs. However, the capital requirements would not be recovered until day-old chicks reach point of lay and start producing eggs. Financing schemes to provide the needed 6 months of working capital to egg farmers to raise pullets could be viable propositions for improving productivity, competitiveness and outputs among SMEs.
- **Producer consolidation:** Generally large-scale commercial poultry operations achieve better feed conversion ratios and therefore lower unit production costs than do small operators. Consolidation in the industry will lead to lower overall average feed costs across the industry and ultimately lower prices for consumers.

- **Retail quantities and pricing:** Especially for chicken meat, there is an opportunity to further the already existing product variety for low income consumers. This could be complemented with demand-generation initiatives to build awareness that chicken meat is the lowest cost ASF in terms of grams of protein per Kwacha.

Dairy value chain

Summary

- There are opportunities to enhance the supply of veterinary and livestock support services in input markets that could manifest in a dairy value chain with higher yields per cow, driving down production costs.
- Opportunities also exist to integrate the currently parallel system of traditional dairy milk production into more modern value chains by supporting improved access through collectives to farm inputs, extension services and capital.
- The number of milk collection centres across Zambia could be increased through investments into satellite processors in remote areas.
- Promotional campaigns targeted at increasing milk consumption among younger school pupils including subsidies of milk and yoghurt in school feeding could make such satellite processors more viable.

Value chain overview

The dairy value chain consists of five main activities. In the Dairy Association of Zambia's (DAZ) classification the sector consists of: (1) allied industries, which provide inputs, equipment and so on to dairy producers; (2) producers comprised of small, emerging and large-scale farmers; (3) milk processors categorised into small, medium and large processors mostly centred in Lusaka; (4) support service providers, including veterinary, nutrition, training, extension, finance, insurance; and (5) supporters like the government agencies, Farmers Association, donors and non-governmental organisations (NGOs) that provide programmes and projects for training, infrastructure and direct support. DAZ data, though not part of official national statistics – offers insights for comparison with other countries in southern and East Africa.

In the six years from 2011 to 2017 Zambia has seen the most rapid recent increase in milk production among comparison countries, at a rate of 179 per cent per annum (Table 3.6). However, because the country's commercial production grew from a very small base, per capita production is still less than a third that of Kenya and less than half that of Uganda and South Africa. There is a deficit in the supply of dairy products like yogurt, ice cream and milkshake. Imported milk powder is used to make these products (Figure 3.3).

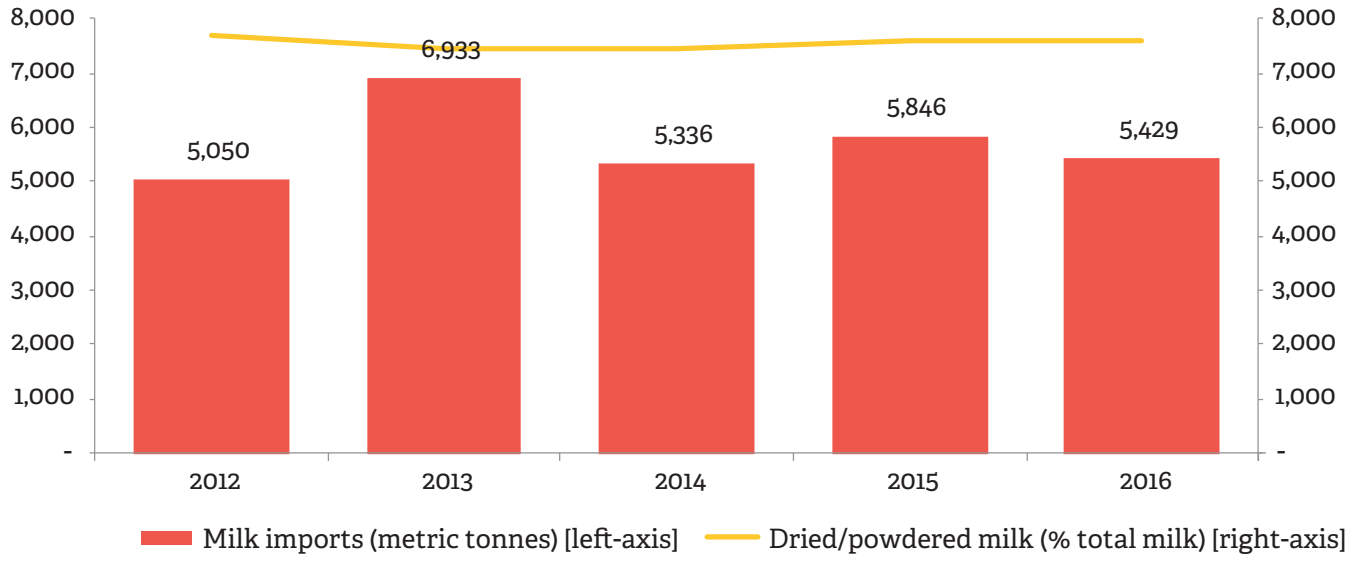
Table 3.6: Domestic milk production (million litres)

	2011			2017			(2017–2011)
	Milk (litres millions)	Population (millions)	Milk per capita	Milk (litres millions)	Population (millions)	Milk per capita	Annual average change (%)
Kenya	2,300	41.4	55.6	5,000	47.2	105.9	19.6
South Africa	2,500	51.6	48.5	3,800	55.3	68.7	8.7
Uganda	1,800	33.9	53.1	2,900	40.1	72.2	10.2
Zambia	40	13.9	2.9	470	16.1	29.2	179
Malawi	6.5	15.2	0.4	9	17.6	0.5	6.4

Source: DAZ (Munyama, 2017)

In 2016, the country imported 5,429 tonnes of milk and milk products with a value of $13.9 million mostly to meet urban demand for products like yogurt, cheese and ice cream. Of this quantity 95 per cent was milk powder (Figure 3.3).

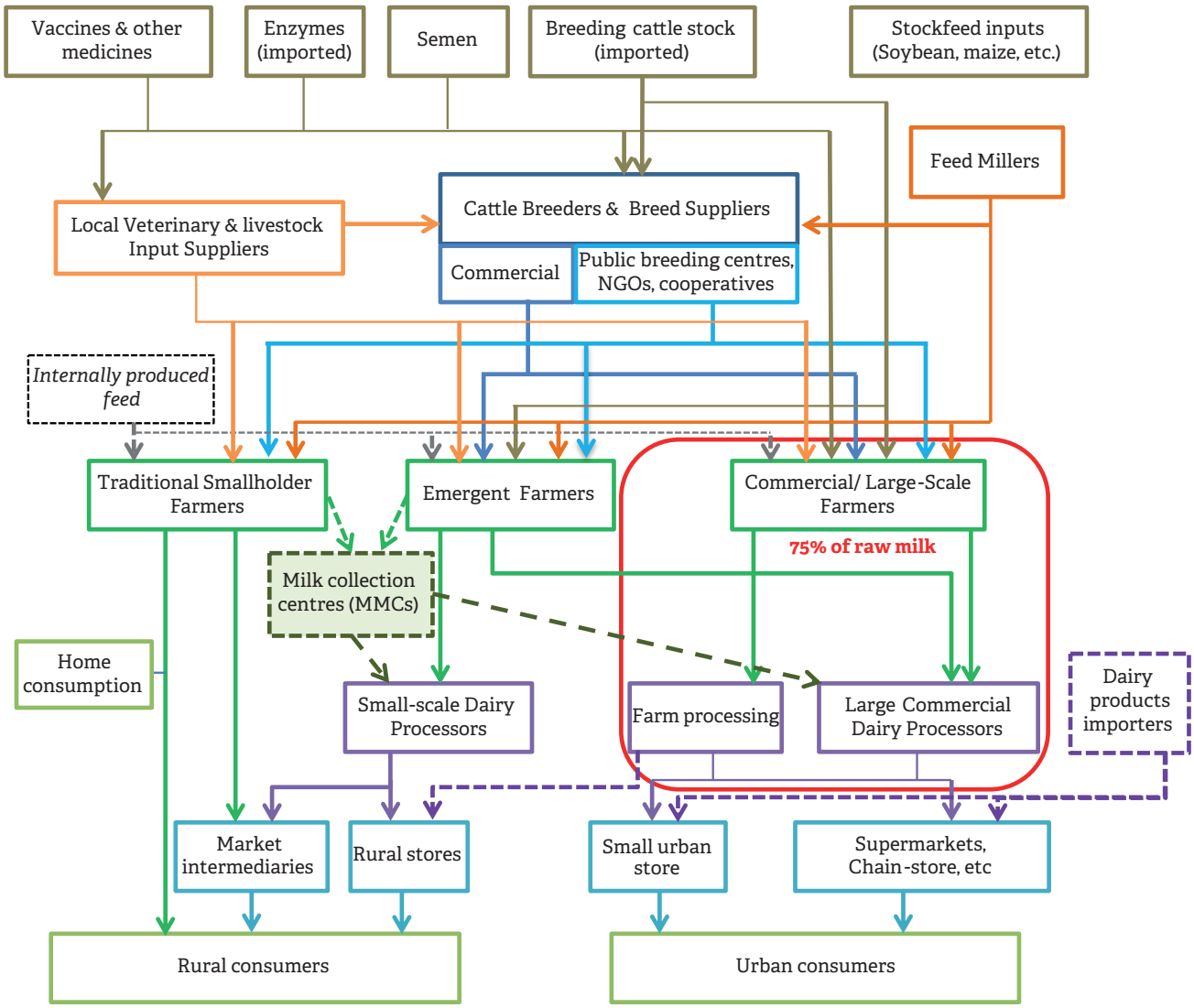
Figure 3.3: Milk imports in tonnes and share of milk imports (% of total milk)



Source: COMESA, COMESTATS database

Figure 3.4 presents an overview of the full dairy value chain in Zambia. It identifies the key segments of: input supply, milk and milk product production, processing and distribution, and rural versus urban consumption. These are considered in the sub-sections that follow.

Figure 3.4: Dairy value chain, Zambia



Source: Authors' construction

Inputs and their suppliers in the dairy value chain

Three types of input suppliers are identified in the dairy sub-section: veterinary and livestock support commodity and service suppliers, cattle breeders, and feed mills. They are now considered in turn.

Veterinary and livestock support commodity and service suppliers provide largely imported commodities and services that are critical for ensuring successful cattle breeding and cattle rearing for dairy. Key commodities include vaccines and medicines, semen, vitamin and mineral premixes, and other inputs. Input suppliers are the main source of veterinary and livestock support commodity for cattle breeders and cattle farmers.

Industry informants find the supply of veterinary and livestock support inputs and services inadequate, with suppliers skewed towards locations in urban areas. The low availability and high costs of drugs and veterinary services are driven by the small customer market. Zambia has few local producers of semen, veterinary products, ingredients and enzymes. There were three main importers two of which were Lusaka-based retail outlets and not distributors with countrywide coverage. Given the concentration of global manufacture of veterinary products, it is unclear whether they could be made locally at a lower cost than imported products.

Input suppliers generally recognise that the use of veterinary products particularly among smallholder and emerging livestock farmers reflects the low-input/low-output system of animal husbandry that has evolved in Zambia. They report attempting to stimulate their target market by, for example, using roadshow demonstrations and coupling sales with use/treatments extension services. However, being comparatively small firms, with limited resources and national reach, these input distributors do not have the capacity to make major in-roads or strides in consumer market stimulation.

Cattle breeders produce and supply dairy cows in Zambia. Breeders may be NGOs and state-sponsored cooperatives on the one hand or commercial enterprises on the other. The cost of breeding animals in Zambia is considered to be high (eg an exotic – or more formally referred to as "Continental European breed" – bull runs from K18,000-K28,000/$1,800 to $2,800). Animals are also in short supply, with the government operating breeding centres that cannot supply enough breeding stock. Private breeders who breed mainly for their on-farm use have taken advantage of the strong demand by raising prices. The dairy industry also faces strong non-tariff barriers, which serve to restrict imports of both heifers and steers. NGOs (eg Heifer International) have introduced many of the improved hybrid breeds found among emerging and smallholder dairy farmers.

Feed mills produce and distribute feed for dairy and beef cattle breeding and feedlots. Several of the feed millers have products for cattle breeding and cattle farming; however, Zambia's feed mill companies mostly focus on poultry feeds with only residual production of beef and dairy cattle feeds. This is partly because commercial, emerging and small-scale farmers are usually vertically integrated. Feed millers recognise that the main impediment to growing a bigger market for cattle feed is its higher cost relative to on-farm mixing of feed. The millers face challenges to convince cattle farmers that compound feeds would result in better productivity and therefore prove to be more economical.

Table 3.7: Stockfeed prices

	Feed price ($ per tonne)		
	Local Zambian	Africa averages	Global averages
Broiler	468*	565	418
Layer	387*	470	363
Dairy cattle	309**	n.a	n.a
Pig	n.a	363	539

Sources:
*PAZ data (PAZ, 2017)
**based on DAZ data (Munyama, 2017)
All other statistics based on Alltech (2018)

Production: dairy farming, milk processing and distribution

At the level of milk production, Zambia's dairy value chain is roughly split into the traditional smallholder segment on the one hand and commercial producer segment including emerging producers on the other. In dairy, Munyama (2017) reports that commercial herds dominate the sector, accounting for 75 per cent of the raw milk sold. As noted earlier, DAZ estimates the total annual commercial milk production in Zambia at about 470 million litres in 2017. Out of Zambia's total cattle production, which grew from an estimated 2.53 million in 1994 to 3.5 million by end 2014, about 20,000 cows make up the country's high-yielding hybrid dairy herd,[11] 70 per cent of which are owned by emerging and large-scale commercial farmers (Munyama, 2017).[12]

11 The breeds include mainly Friesians, Jerseys, hybrid crossbreeds and a few Ayrshires (DAZ interview).
12 The latest statistics are relatively old (2014) because Zambia has not conducted a livestock census or comprehensive survey so that the true stock of livestock at any given baseline is not well known.

The commercial dairy segment is dominated by four or five large dairy processors, two of whom run producer dairies (ie own their own dairy herds) (Nathan Associates, 2010). DAZ (Munyama, 2017) lists the four large-scale producers with production capacity of over 10,000 litres a day as Parmalat, Zambeef/Zammilk, Varun Food and Beverages, and Finta. Neven et al (2017) add a fifth, Diamondale Milk, although it does not qualify as a large-scale processor according to the DAZ definition[13] (see also Table 3.8). The dominant player, Parmalat, accounts for roughly half (50%) of the commercial market. However, Parmalat is an independent processor, with about 14 per cent of its raw milk being sourced from emerging farmers. The willingness and ability of this major international dairy company to collect milk from collection centres established by NGOs like Heifer International or government-sponsored cooperatives has played a significant role in assisting the development of the emerging farmer segment of the value chain. Neven et al (2017) highlight the importance of the emergence of milk collection centres in fostering greater participation of smallholder farmers in the commercial dairy value chain.

Table 3.8: Milk production estimates, 2017

	Annual production (litres)	Daily production (litres)	Installed processing capacity (daily litres)	Capacity use (%)
Raw milk	470,000,000	1,287,671		
Pasteurised milk	74,241,000	2,03,400	565,000	36
of which Parmalat Zambia[1/]	37,120,500	101,700	180,000	57
Zammilk[2/]	18,900,000	51,781	135,000	38
Finta Farms[1/]	8,928,045	24,460	120,000	20
Varun Food and Beverages[1/]	8,017,020	21,964	120,000	18
Diamondale milk[1/]	1,275,435	3,494	10,000	35

Notes:
1. Estimates of annual and daily (raw and pasteurised) milk production based on triangulation of data and information in World Bank (2017), Munyama (2017) and Neven et al (2017)
2. Same as 1, but including information from the 2017 Zambeef Annual report (Zambeef, 2018) indicating that Zammilk commissioned a $1.2 million rotary milking parlour at its Kalundu Dairy Farm to improve efficiency and made a $900,000 investment in extra processing capacity at the Huntley facilities.

The second-largest commercial dairy producer, Zambeef, accounts for about 20 per cent of the commercial market. Zambeef has also emerged as an independent processor as the company draws on emerging farmers as a source of raw milk.

The three systems of dairy farming – traditional, emerging and commercial – are differently motivated, employ different production practices, and have different performance outcomes. Commercial farmers produce their milk using exotic breeds (mainly Jersey and Friesian) to achieve daily milk yields of 10 to 23 litres per cow. Emerging farmers rear cross breeds with yields of 7 to 10 litres, and traditional (small-scale) farmers use indigenous breeds yielding 1.5 to 2.0 litres. Traditional farmers process the milk themselves for sale in the rural neighbourhood or in the nearest town or city. The other two systems employ various mixes of own-processing and use of independent commercial processors.

13 DAZ definitions: (1) Large-scale processors, processing 10,001 litres per day and above (Parmalat, Zambeef, Varun Foods & Beverages, Finta Farm); (2) medium-scale processors, 1,001 to 10,000 litres (Diamondale, Dairy King, Sayyah, Nice and Icy); and (3) small-scale processors, up to 1,000 (MukupaWesu, Ilya, Choma and Mpima Dairy Coops etc).

The total installed milk pasteurisation capacity is 565,000 litres per day. In 2017 capacity use was just 36 per cent. This low rate is attributed to poor road infrastructure and inadequate milk collection centres. Raw milk production in Zambia was 470 million litres. Only about 16 per cent or 75 million litres was pasteurised (Munyama, 2017).

Distribution and retail

The distribution and retail sales of milk and other dairy products are underpinned by a well-developed and well-organised wholesale and retail trade services industry to urban customers. Independent processors generally use both wholesale and retail intermediaries and their own in-house distribution channels and sales outlets. There are no major challenges, bottlenecks or binding constraints highlighted in the literature or by the key informant interviews, which are unique to this segment of the dairy value chain. Generic challenges are poor infrastructure in milk shed areas including substandard road networks, poor connectivity to the electric power grid (and frequent power outages where connections exist), inadequate milk collection centres, and the high cost of fuel increasing transportation costs. Volatile exchange rates affect dairy processing operations to the extent they rely on imported milk powder. There are frequent shortages of maize bran due to policy changes in the procurement, marketing, logistics, distribution and storage of maize, which is Zambia's staple food.

Potential opportunities

- **Stimulating demand for inputs:** supporting input suppliers' efforts to increase the use of veterinary and livestock support commodities among (smallholder and emerging) cattle breeders and dairy farmers. For instance, this could be through aiding the establishment of organised, reliable and trusted input distribution networks with integrated technical advisory services in smallholder and emerging breeder areas. Such efforts could promote the emergence of a dairy value chain with higher yields per cow and lower unit production costs; contributing to increased availability of affordable milk and milk products.
- **Better integrating traditional producers into commercial systems**: there is scope to support the integration of the currently parallel traditional system of dairy milk production with the more modern commercial system. This could be by systematically identifying traditional dairy farmers and supporting them with improved access to affordable technologies, restocking their herds with high-yielding breeds of dairy cattle, extension services, training and low-cost operating capital. The goal would be to transform them into emerging farmers who can readily supply the independent processor segment of the value chain. In general the short-term positive implications of focusing on the SME traditional dairy milk producers is they would increase productivity, earn higher incomes and increase self-consumption. Non-milk producing rural households still might remain excluded from milk consumption, though inclusion of milk in school feeding as a public policy initiative could help solve this.
- **Supporting the development of milk collection centres:** business opportunities appear to exist in the industry to increase the number of milk collection centres. DAZ plans to set up 200 more milk collection centres across Zambia in the five years from 2017 to 2021 and to lobby for public, private and public–private partnership investments in satellite MSME processors in remote areas, tying these to demand generation campaigns targeted at young school-goers under Zambia's expanding national school feeding programme.

Beef value chain

Summary

- Traditional cattle husbandry should be further integrated into the commercial supply chain. The bulk of Zambia's beef industry still depends on traditional rearing systems, meaning that only a small part of it benefits from the productivity, competitiveness and increased revenues and profits that come with modern approaches to cattle rearing.
- Commercial players should continue to expand current programmes helping traditional cattle farmers to improve their breeds, gain greater access to and training in the use of veterinary drugs and adopt basic business practices.
- Traditional herders through extension services and promotion of commercial value-chain integration can be supported to generate cash from their herds. The public and social sectors also have roles to play in supporting the traditional sector to formalise.
- Extending public infrastructure such as roads, electrical grids and cold-chain facilities also presents a way to unblock the bottleneck of prohibitively high logistics costs for private producers to reach lower income populations – but this remains largely outside the purview of the private sector.

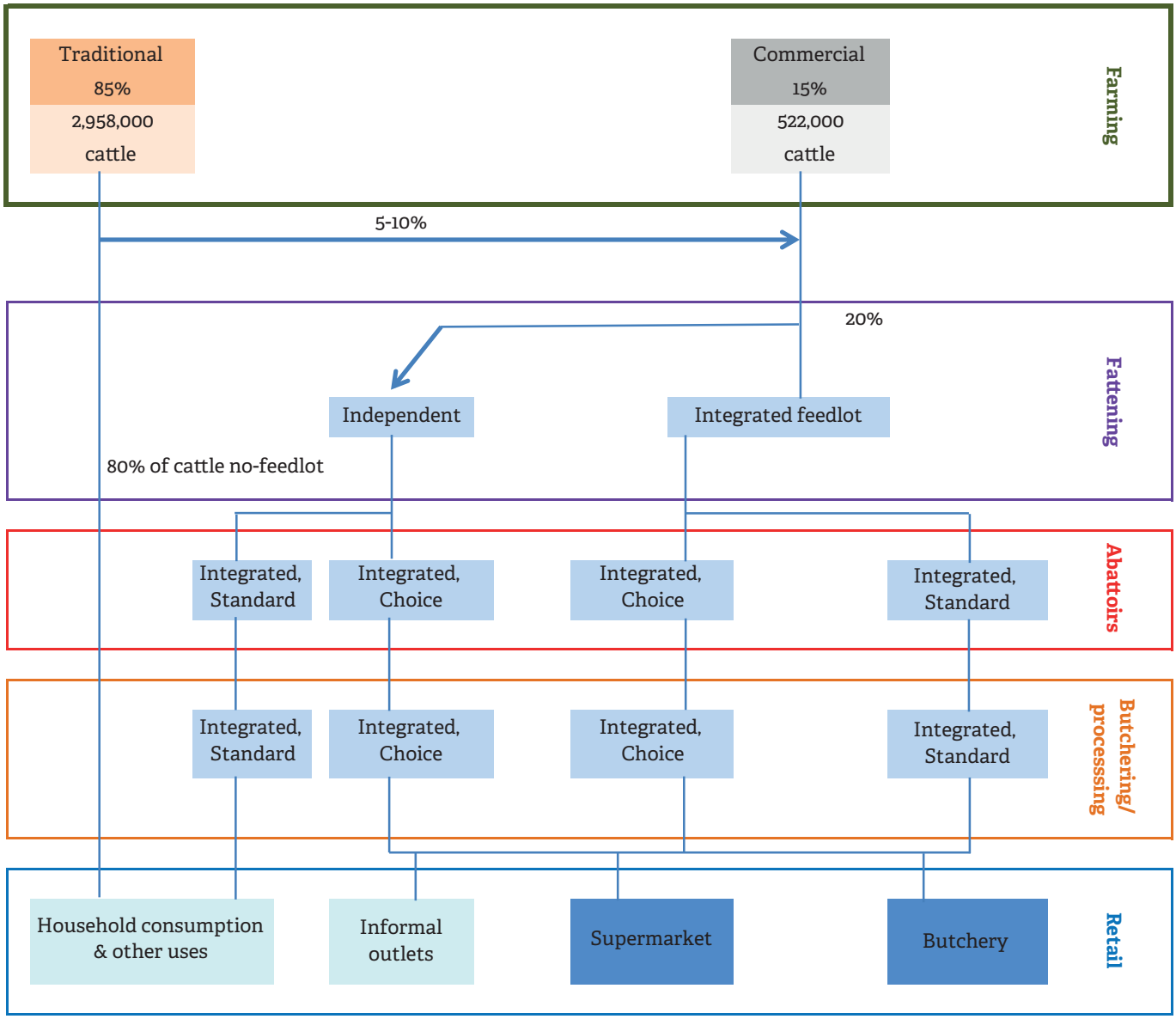
Value chain overview

Beef was the most preferred ASF for a long period in Zambia, particularly during the nationalised state-led economy (1964–1991). As the economy was liberalised and most agricultural subsidies for livestock were removed from 1992 onward, beef production turned commercial accompanied with cost-reflective pricing. Beef is largely consumed in middle and high income households, mainly because of high unit prices. In Figure 1.4 (earlier), mixed cut beef (the cheapest beef cut) at K35 per kg was seen to be 29 per cent more expensive than frozen chicken (K27 per kg). Like dairy, the beef value chain is understood within the feed-to-farm-to-fork framework (UKAid and World Bank, 2011).

The livestock feed component is a crucial determinant of the structure, performance and price competitiveness of the entire beef value chain. Zambia's beef industry is well developed with enough production to meet domestic demand at current price levels. For instance, in 2016 Zambia's bovine meat imports were only $297,000 compared with $88.6 million for Angola and $14.6 million for the DRC (COMSTATS). Zambia's feedlot operators benefit from a normally sufficient supply of maize, which is typically used for fattening cattle for three months before slaughtering. Ample grazing and the competitive maize costs do a lot to explain why cattle meat imports are negligible.

Figure 3.5 depicts the key segments of the beef value chain: from input sourcing to farm production, meat processing and distribution, and consumption. The segments are discussed in turn in the ensuing sub-sections.

Figure 3.5: Beef value chain in Zambia



Source: Author's construction, building on UKAid and World Bank, 2011

Inputs and input suppliers in the beef value chain

Three types of input suppliers are identified in the value chain. These are veterinary and livestock support commodity and service suppliers, cattle breeders and feed mills. Their organisation is similar to the dairy value chain.

Production: Beef livestock farming

Zambia's beef value chain has been shaped by two forces: (1) a clear distinction between a commercial market segment that mainly serves the urban consumers and a traditional segment that meets the consumption and social needs of the rural population; and (2) the comparatively recent emergence of the private sector in the commercial beef industry. Private sector participation began less than 25 years ago while beforehand, the public sector dominated the industry. Thus the sector's development is still immature. Only 522,000 head of cattle equivalent to 15 per cent of the national stock in Zambia are reared in the commercial system. Most of the commercial animals go through the feedlots and 20 per cent of cattle reared in the traditional system find their way to feedlots as well (Nathan Associates, 2010).

The traditional market segment is informal. Slaughtering is performed at an abattoir if available but rural households raise most cattle and consume them on social occasions. Or they sell the cattle to rural butchers in the informal economy. As recently as 2012, 57 per cent of cattle were slaughtered in the informal sector (Nathan Associates, 2010). This correlates with the 60 per cent of Zambia's population who were rural at the time (UKAid and World Bank, 2011).

In contrast, the commercial segment of the beef industry is formalised and has grown rapidly driven by an increase in the size of the urban middle class in Zambia. The case of Zambeef (Box 3.1) illustrates this quite well and also offers a forward-looking outlook of the industry in the near future, from the perspective of a well-established, purely private sector firm resident in Zambia.

Box 3.1: Case study – Zambeef optimism about rising consumer incomes and enhancing supply responses

In 2014, Zambeef, the largest supplier of beef in Zambia, published this outlook on Zambia's consumer market:

- Zambia is one of the fastest-growing economies in sub-Saharan Africa.
- Average GDP growth is more than 6.5% over the last five years and forecast to grow at 6% per year over the next three years.
- There is a rapidly expanding consumer base, driven by an emerging middle class and high levels of urbanisation.
- The population is 13.6 million people.
- Zambia has one of the world's fastest-growing populations, expected to reach 16 million people by 2017.
- GDP per capita has increased from $1,110 (2009) to $1,487 (2013) and is expected to be more than $2,000 by 2017.

Against this outlook, among other strategic investment decisions, Zambeef embarked on a further expansion of its retail and wholesale networks to widen its footprint across Zambia, and of its production capacity across its cold-chain food production facilities. The annual average increase in the number of Zambeef's own outlets and Zambeef-managed Shoprite butchery outlets increased by 12% per year (Table 3.9), demonstrating optimism about the future.

Table 3.9: Zambeef and Zambeef-managed outlets, 2014–2017

	2014	2015	2016	2017
Zambeef retail outlets	n.a.	85	83	78
Zambeef macros	4	6	10	19
ZamChick inns	7	6	4	3
Novatek	n.a.	5	10	17
Zamshu outlets	n.a.	0	2	12
Zambeef outlets	92	102	109	129
Annual change (%) in Zambeef outlets		11	7	18
Shoprites	22	26	31	31
Annual change (%) in Shoprite outlets		18	19	0
Total Zambia	114	128	140	160
Annual change (%) in total outlets		12	9	14

Source: Zambeef Annual Report 2014 and Zambeef Annual Report 2017

The two segments of the beef industry are increasingly interconnected. About 20 per cent of the cattle reared in the traditional system now ends up being slaughtered in modern, commercial abattoirs. Smallholder farmers sell cattle to pay for school fees or other incidentals or when their households need cash due to illness or crop failure.

In the commercial segment, the industry has a broadly agreed two-tier classification system: integrated 'choice' or integrated 'standard' meats, depending on whether the animal has been fattened in a feedlot or not. The term 'integrated' is used to highlight that by the abattoir stage, the sources of the animal, whether traditional or commercial, does not matter, and the distinction is only on 'choice' (feedlot fattened) and 'standard' (not feedlot fattened). It is also important to note that some animals that enter the feedlot line do not actually get treated or feedlot fattened (eg when the feedlot intermittently runs out of stock feed), implying that the beef from this line is designated as standard. Thus, the bulk of the commercial market by volume and value is standard meat, both from being channelled through the independent line and non-fed part of the feedlot segment. The cattle from the traditional system or from emerging farmers are slaughtered without feedlot fattening, so are also classified as standard (Nathan Associates, 2010; UKAid and World Bank, 2011).

The 2010 study found that 5 to 10 per cent of cattle from emerging and traditional farmers were being fattened alongside animals from commercial farms (Nathan Associates, 2010). This figure may be much larger now, which would suggest that the larger commercial farmers are supporting the integration of traditional and smallholder farmers into the modern segment of the industry.

Processing, distribution and retail

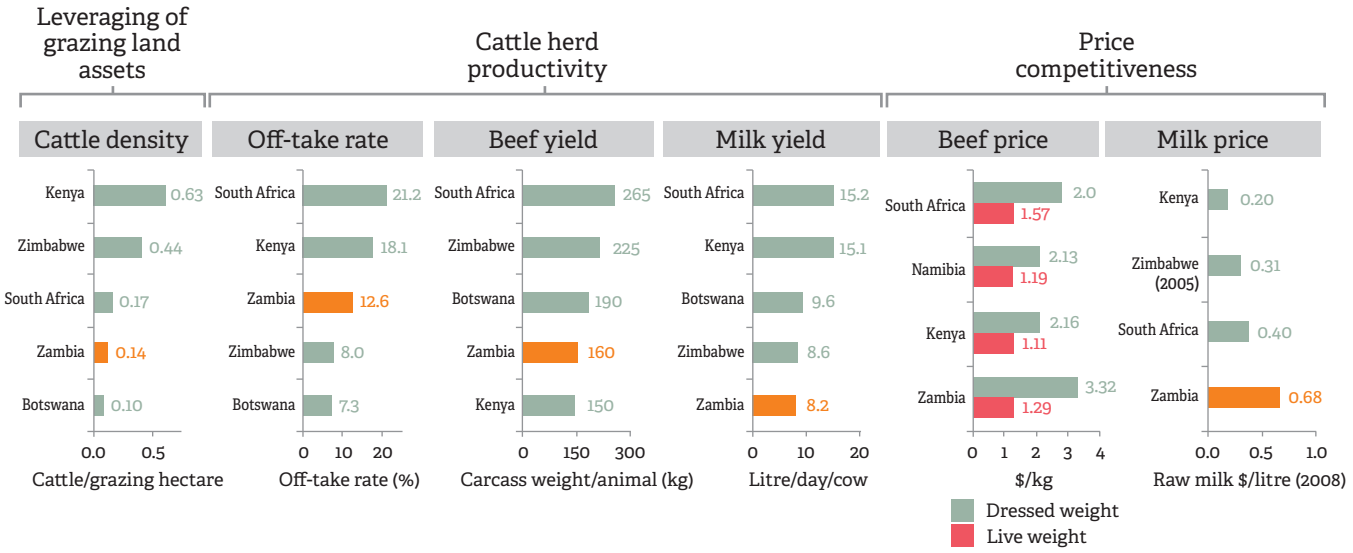
According to the World Bank, the key features of cattle processing in the commercial system are as follows:

- **Most feedlots, abattoirs and modern butcheries are owned by firms that have full vertical integration or are integrated from feedlot to retail butchery outlets.** Zambeef – the dominant firm in the commercial beef industry – and another major player are both fully integrated from cattle ranch to butchery and a number of the second-tier players are integrated from feedlot to butchery. However, several new entrants have chosen only to invest in abattoirs and butcheries. These predominantly serve the standard meat segment.
- **There is growing interest in fattening cattle for the choice market.** Originally, there was only one major firm operating feedlots. However, according to reports, the entry of modern retailers needing increasing volumes of quality meat cuts has caused several others to open up feedlots (Nathan Associates, 2010; UKAid and World Bank, 2011). There are now eight or nine beef producers able to meet the needs of major food retailers like Shoprite, Pick-n-Pay and Spar. Industry sources report healthy returns on feedlot investments. More new entrants can be expected.
- **Reports note that by 2010 and 2011 significant new investments had emerged in abattoirs in the urban centres of major cattle rearing provinces as well as in Lusaka and the towns of the Copperbelt** (Nathan Associates, 2010; UKAid and World Bank, 2011). At country level there is no shortage of capacity but there may be capacity constraints in certain provinces, particularly when the bans on cattle movements are enforced in response to the frequent outbreak of disease.
- **The rise of modern retailing in Zambia has caused all the major beef producers to understand the importance of securing outlets in the main shopping malls or selling beef in modern butcheries**.

- **Unlike in South Africa and in other developed countries, there is no formal wholesale market for beef in Zambia.** As a consequence, the large supermarket chains have opted to let beef producers open franchised outlets in their stores rather than operating their own butcheries as is the practice in South Africa and most developed countries.

UKAid and the World Bank (2011) argued that in Zambia, industry maintains bargaining power over farmers and the consumer. This was reflected in the relatively high price of beef at wholesale (dressed weight) and retail levels, particularly compared with other countries like Botswana, Kenya, South Africa and Zimbabwe (Figure 3.6). This will only change if the rate of new entrants and investment into the industry in Zambia continues at a high pace. Ultimately, this will increase competition and consumer choice. The high level of vertical integration of the beef sector in Zambia had been symptomatic of an immature industry. It reflects the recent emergence of competition between private firms.

Figure 3.6: Key performance indicators in Zambia's beef and dairy industries



Source: UKAid and World Bank, 2011

Potential opportunities

- **Integrating traditional producers into commercial value chains:**
  - **Because the bulk of Zambia's beef industry still depends on traditional rearing systems, only a small part of the industry benefits from the productivity, competitiveness and higher revenues and profits that come with modernisation and technological enhancement.** Supporting traditional farmers to modernise their farming and business practices, to mobilise additional capital and improve their cattle breeds would yield productivity and revenue gains for the farmers and eventually lower prices for consumers including low income households in underserved areas. Commercial beef producers often with the support of NGOs have already launched programmes to provide cattle with superior genetics to improve the herds of traditional farmers. They are also seeking to make veterinary drugs more available and to train farmers in their use. Training in business practices is included in extension-type awareness building and technical/technological support services.
  - **Commercial producers could serve as champions** for scaling up the feedlot system by providing facilities to smallholder traditional farmers under lease or lease to own arrangements.

- **The informality of a large part of the industry may result in broader negative spillovers that are hard to quantify** – for instance, slaughtering animals without an abattoir raises multiple risks around food safety, health, sanitary, quality standards and environmental standards, which can impose significant direct and indirect economic costs. Supporting the traditional system to formalise through public–private partnerships and public programmes would be key for promoting modernisation and fostering efficiency gains, including price reductions and broader benefits.

+ **Public investment to create an enabling environment:** public investment is critical to extend public infrastructure (roads and feeder roads, electricity, storage and cold-chain facilities and so on) to bring to rural customers and traditional producers into commercial value chains.

Aquaculture value chain

Summary

+ Farmed fish, both imported and domestically raised, is now the most consumed ASF in Zambia
+ Based on the increase in domestic aquafeed output, it is likely that farm fish production will triple in the two years from 2016 to 2018.
+ Continued rapid growth in domestic aquaculture presents a major opportunity to enhance the availability of affordable proteins to both the rural and urban population. At the same time it would decrease reliance on imported fish, which in 2014 still accounted for 46 per cent of farmed fish consumption, mainly tilapia.
+ The national shortage of juvenile production in hatcheries is a major constraint to expanding local aquaculture. There are opportunities to address this by investing in private hatcheries or by working with the government to recapitalise, modernise and operate public hatcheries, which operate well below capacity.
+ The existence of only one large commercial fish processor means there is an opportunity for greater competition and substantial incentives to innovate and further drive down prices. Increased supply of processed, frozen, dried or otherwise preserved fish could extend the market reach of processed fish beyond typically well-served urban areas.

Value chain overview

Following increases first in imports and recently in domestic output, farmed fish is now the most consumed ASF in Zambia. As Figure 2.7 shows, total fish supply in Zambia was estimated at 239,000 tonnes in 2016, more than 2.5 times the level of 69,000 tonnes in 2006. Local production including both aquaculture and capture production fell from 94 per cent of total fish supply in 2006 to 47 per cent in 2016, while conversely the share of imported fish increased from 6 per cent in 2006 to 53 per cent in 2016 (estimated from a combination of Namonje-Kapembwa and Samboko, 2017 and COMSTATS database[14]).

14 Statistics are from COMESTATS (COMESA Statistics) database: http://comstat.comesa.int/lplbop/merchandise-trade-by-commodity-hs2012

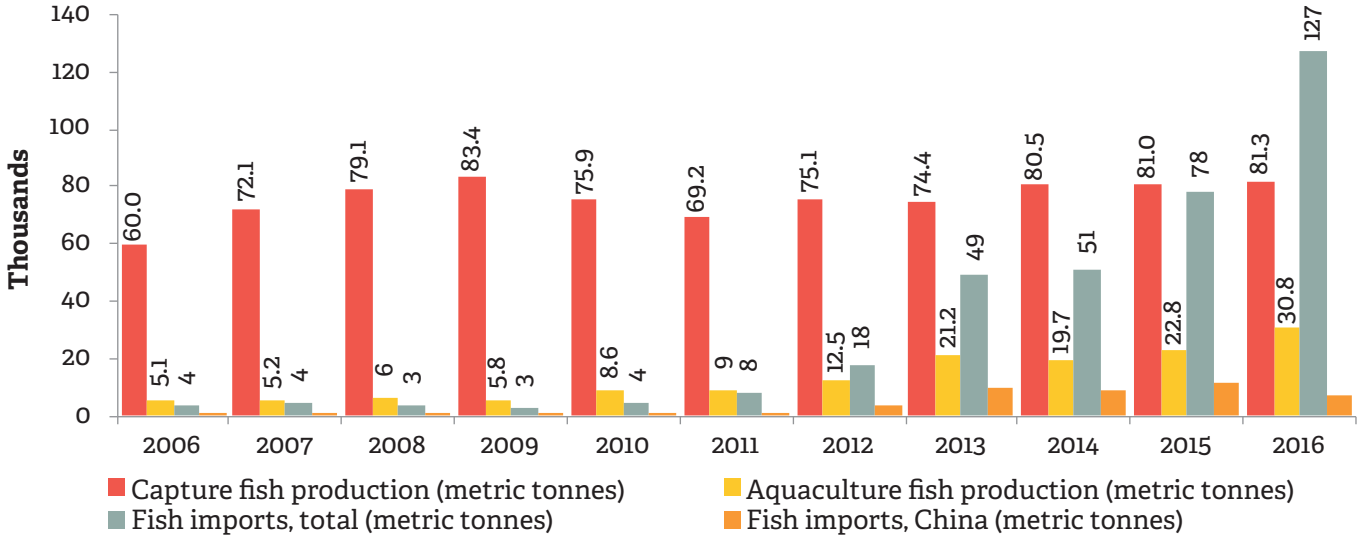
In 2017 two globally operating Scandinavian companies started up dedicated aquafeed plants with total capacity of 85,000 tonnes per year. This means a tripling in fish feed output compared with 2016, and a corresponding rise in domestic farmed fish output over the level of 2016.

In terms of local production, Zambia has over 15 million hectares of water bodies like rivers, lakes, reservoirs and swamps, allowing extensive freshwater fisheries (World Bank, 2017). There are two types of fish production: capture fishing and fish farming (or aquaculture). In wild capture fisheries, commercial and smallholder operators depend on natural replenishment of fish stocks for sustainable harvests.

The best-organised wild capture fishery is kapenta (Taganyika sardine) in a number of large lakes including Kariba, Tanganyika and Bangweulu. Kapenta is an important source of protein for many rural and urban population groups in Zambia. It is convenient for rudimentary processing. After the small fish are dried in the sun, storage and transport are easy. Kapenta is caught at commercial scale in several lakes, where private fishermen operate under a permit system. The activity is capital intensive, requiring relatively large fishing rigs with special lighting and gear. Since it is capture and not aquaculture, kapenta fisheries have fewer formal links up the value chain. High per unit retail prices and overfishing mean that promoting kapenta as an affordable food for low income and generally underserved populations is problematic (Mukuka and Mofu, 2016).

Aquaculture is fish farming in artificial earthen ponds or in the same bodies of water alongside capture fisheries (World Bank, 2017). In the large lakes, tilapia is mainly reared in floating cages. Compared with capture fishing it is a highly organised, modern and capital-intensive activity. Zambia's commercial aquaculture is still relatively young but has grown by 29 per cent per year on average from 2010 to 2016, from a production level of around 8,600 tonnes in 2010 to over 30,800 tonnes in 2016 (Figure 3.7). In 2017 and 2018 production rose even more rapidly perhaps doubling or even tripling based on the output of the new dedicated fish feed plants. Aquaculture production volumes were nearly three times less than the volumes coming from capture fisheries as of 2016. The African Development Bank (AfDB) estimated that in 2014 total fish production (both capture fisheries and aquaculture) was 100,107 tonnes compared with a demand of 185,000 tonnes, implying that about 46 per cent of estimated demand is still unmet by local production. Unsurprisingly therefore, Zambia imported $94.2 million, $133.2 million and $81.6 million worth of fresh fish in 2014, 2015 and 2016. Of Zambia's eight neighbouring countries only DRC and Angola imported more fish. The large import volumes emphasise the need for continued expansion of domestic aquaculture as fish gains popularity across more and more population segments as a source of dietary protein.

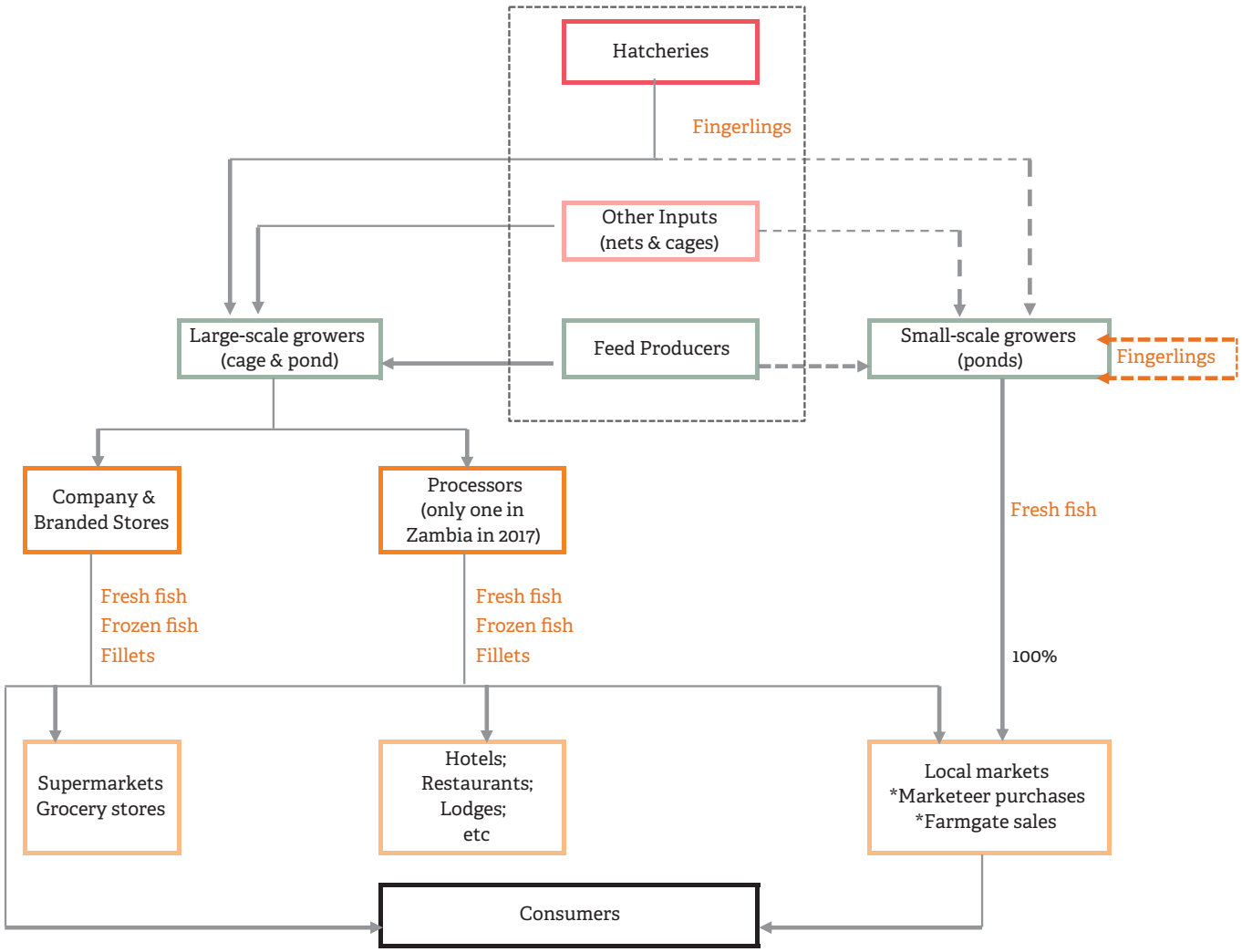
Figure 3.7: Fish consumption in Zambia (thousand tonnes per year)



Source: Namonje-Kapembwa and Samboko, 2017 and COMSTATS database

Large markets for fish already exist in Zambia and in neighbouring countries. For example, average annual fish imports by Angola, DRC and Mozambique were $128.3 million, $94.4 million and $51.0 million, respectively (2014–2016). However, to maximise opportunities in these markets, Zambia's aquaculture industry would have to do much more to harness the country's vast water resources. The favourable trade protocols in the Common Market for Eastern and Southern Africa (COMESA) and the Southern African Development Community (SADC) create a conducive environment, though bilateral trade agreements with Angola and DRC have not yet been implemented under the SADC and COMESA Free Trade Areas. Ultimately these arrangements should allow for duty-free and quota-free market access to most of Zambia's neighbours.

Figure 3.8: Aquaculture value chain in Zambia



Source: Global Development Solutions, LLC as in World Bank, 2017

Input suppliers in the aquaculture value chain

The aquaculture value chain in Zambia has three key types of input suppliers, namely: *hatcheries*, *fish feed and aquaculture equipment*. They have the following characteristics:

Hatcheries: The World Bank (2017) reports there are eight private and nine public hatcheries in Zambia that breed juvenile fish. Four private hatcheries operate in Lusaka, three in Copperbelt and one in Southern Province. Even though the largest concentration of small-scale fish farmers in Zambia is in Northwestern province, there are no private hatcheries.

Public hatcheries are also underused – of the nine that are government-owned, seven are underused due to working capital constraints and the remaining two have never been operational. The severely limited availability of juveniles from public and private hatcheries means many farmers either produce their own fingerlings in-pond or purchase fingerlings from other small-scale farmers who breed fingerlings in-pond (World Bank, 2017).

Feed producers: up until 2016, Zambia had six established fish feed producers with a cumulative annual production of about 30,000 tonnes (AfDB, 2016). Two new, dedicated aquafeed plants were started up in 2017 in Siavonga, Southern Province. Two leading Scandinavian fish feed producers with a global presence, Skretting of Norway and Aller Aqua of Denmark, contributed much of the capital. Aller Aqua's factory represented a $10 million investment, with a nominal capacity of 14 tonnes per day or about 50,000 tonnes per annum. It is a joint venture with Oakfield Holdings Limited, an investor in Yalelo, one of the world's largest producers of tilapia. Yalelo has an off-take agreement with Aller Aqua and plans growth of 50 per cent per annum. Aller Aqua will also be able to supply feed to small-scale fish farmers around the country. The Aller Aqua fish feed factory includes a training facility for fish farming funded by a Danish NGO.

Norway-based Skrettings, a subsidiary of Nutreco in the Netherlands, has entered into a 75/25 joint venture with African Century Foods, which has large tilapia farming operations in Zambia, Zimbabwe and Uganda (Lake Victoria) and sells under the Blue Harvest brand. Its plant has 35,000 tonnes annual capacity according to press releases at launch in April 2017.

Since 2016, total fish feed production capacity has thus increased by a factor of four to a total of 115,000 tonnes per year.

An important consideration in producing fish feed is that it requires high protein soya bean meal. Estimates indicate that fish need feed with higher protein content – up to 70 per cent soya bean meal – and less fibre than almost any other type of feed, for maximum conversion ratios and rapid growth.

Fish: farming, processing and distribution

Fish producers: fish production cycles vary between small-scale farmers and large commercial producers like Yalelo in Siavonga on the shore of Lake Kariba. Small-scale operators harvest after eight or nine months while large-scale producers are able to achieve two harvests per year. The longer maturation period and resulting lower yields among small-scale producers are due to suboptimal feeding regimes, in-pond breeding and operation of mixed-sex ponds. A World Bank survey of 43 smallholder farmers found that the pond capacity use rates were low in both Lusaka and Northwestern Province (60 and 49 per cent respectively), suggesting that farmers were capable of producing considerably more fish with existing capacity. The low capacity use rates were linked to the increase in feed costs following the weakening of the Kwacha in 2015 and 2016.

Pond-based aquaculture is concentrated in Northwestern and Lusaka provinces, with the farms being largely small-scale operations. An exception is a large commercial fish farm in Lusaka. The average size of farms surveyed by the World Bank was 0.4 hectares in Northwestern Province and around 0.3 hectares in Lusaka, excluding the one large farm. The single large-scale farm, Kafue Fisheries, operates with 130 ponds with an area of 97 hectares. The shortage of hatchery juveniles meant that 71 per cent of farmers retained fish to produce their own juveniles. These farmers saved 23 per cent of their fish on average as 'seed'. Such a practice reduces their gross revenues by K34,000 ($3,400) per hectare (World Bank, 2017).

Processing, distribution and retail

Processors: World Bank (2017) lists Capital Fisheries as Zambia's only independent commercial fish processor. The company purchases fresh fish from Kafue Fisheries, a large-scale farm in Lusaka province and from African Century Foods' Lake Harvest, which operates on both the Zimbabwean and Zambian sides of Kariba Lake. Capital Fisheries mainly, however, imports frozen fish from Asia. Capital Fisheries previously purchased from Yalelo, but Yalelo has now vertically integrated its value chain from production only to production and distribution through the retail level. In 2018 Yalelo launched its own downstream processing and distribution. It has built up a network of retail outlets in Lusaka. Local fish purchased by Capital is processed and distributed throughout major cities in Zambia. Capital sells 50 per cent of its fish whole on ice in Capital-branded retail shops. Of this, 45 per cent is blast frozen and sold to supermarkets, 3 per cent is sold gutted to hotels and restaurants, 1 per cent is sold filleted to hotels and restaurants, and 1 per cent is dried and smoked.

Distribution: The 2017 World Bank study notes that small-scale producers sell about 77 per cent of their production (on a farm-gate basis) to individual consumers or collectors on local markets. (Global Development Solutions in World Bank, 2017). These smallholders keep 11 per cent of their output for household consumption and another 11 per cent as seed (as opposed to the 23 per cent noted in the World Bank survey sample). In-kind wage payments are just 1 per cent of output. Distribution is restricted to local markets since smallholder farmers do not have access to cold chains.

There are no reliable statistics on distribution. However, the World Bank (2017) does describe distribution channels of a few key players. Kafue Fisheries distributes 5 to 19 per cent (5 to 23 tonnes) of its monthly output to the Copperbelt. Capital Fisheries, which was procuring 50 tonnes of fish per month from Kafue Fisheries (Lusaka) and until recently Yalelo (Siavonga/Lake Kariba) and distributed this throughout the country to supermarkets and to its own fish retail shops. The economic feasibility of extending distribution to more parts of the country is not immediately obvious; it could be a strategy to increase brand visibility and secure future market shares through early loyalties.

Retailers: Other than the local marketing avenues discussed earlier, fish from small-scale farms is not sold in formal retail spaces. Large companies have multiple retail outlets and sell especially in company-branded stores. They also have fleets of vehicles constituting company-branded mobile sales and delivery units. These deliver to distributors for hotels and restaurants, and individual vendors reselling in street markets as well as bringing fish to private homes.

Potential opportunities

- **Developing more hatcheries:** the national shortage of hatchery-based juvenile production is the major constraint to expanding aquaculture. There are opportunities to establish private hatcheries or partner with the government to recapitalise, modernise and operate the public hatcheries based on a public–private partnership or simple lease arrangement.
- **Supporting small-scale farmers to improve yields:** improving the productivity and yields of small-scale fish farmers requires support services that improve access to affordable and consistent fish feed, strengthen the feeding regimes, and stem in-pond breeding and the operation of mixed-sex ponds.
- **Promoting competition in commercial processing:** A single independent commercial processor means there is limited competition to stimulate innovation and other price-reducing competitive behaviours in this segment of the value chain. There is potential for new entrants to increase competition and extend market reach beyond just urban areas.

4. Conclusion: Actionable propositions

Summary

- This broad-based study shows that commercial enterprises have potential to profitably sell ASFs to large low income and underserved populations in Zambia including poor people in rural areas.
- Actionable propositions for individual businesses include those related to production (eg investing in high protein soybean meal to increase the efficiency of aquaculture feed), financing (supply-chain credit to SMEs to drive up input supply) and distribution models (investing in cold-chain distribution and solar refrigeration to expand product reach).
- At an industry-wide level, actionable propositions relate to collective action around raising awareness (nutritional labelling, advertising), setting standards, extension services, etc.
- For public policy, propositions relate to industry advocacy around subsidising prices of products for consumers (eg school-feeding programmes) and reducing production costs by reducing restrictions and tariffs on imported inputs.
- Although opportunities exist across value chains, the rapid increase in farmed fish consumption during the last ten years is Zambia's most compelling ASF story, since farmed fish is now more important than poultry in the national diet and looks to widen its lead.

Zambia's value chains for poultry, fish, beef and dairy products have developed rapidly over the last 10 to 20 years mostly to serve the animal source protein food needs of the urban population. The 45 per cent of Zambians who live in cities are much better off (in terms of accessibility and affordability of quality, commercially produced ASFs) than in the past. Nevertheless, this study has shown that commercial enterprises still have an opportunity to profitably sell ASFs to large underserved population groups in Zambia including poor people in rural areas. Zambia's 1.54 million small-scale farm households spent K5.1 billion (USD510 million) in cash on food in 2015 (LCMS 2015). A high proportion of this spending was on animal proteins.

More recent and focused household survey data reveals substantial unmet demand for quality animal proteins. Not only is there demand, but survey data included in this report shows that low-income and typically underserved consumers present a substantial market demand if businesses can reach them at scale. Affordability, quality and availability all drive preferences for different animal proteins – principally fish, meat and poultry – with cultural factors that dictate tastes also playing a role. There are opportunities then to serve these customers directly (eg through well-placed commercial outlets) or indirectly (eg through supplying to local markets). These interventions can contribute to driving down costs of access, which together with lower prices (through driving down production costs) can materially enhance the affordability of protein-rich foods to low income and underserved consumers.

Reaching such consumers will depend a great deal on how rapidly commercial processors extend their cold chains for distributing poultry, fish, beef and dairy products in part by capitalising on projects underway to expand road infrastructure and electrical grids to poorly served areas. Better roads and power will at the same time enable large food processing firms to procure more raw milk, poultry, cattle and farmed fish from rural areas outside the main corridor of development from Lusaka to Copperbelt province. Such commercial links will increase disposable incomes in rural areas and result in more spending on a range of commercially produced animal proteins.

The rapid increase in farmed fish consumption during the last ten years is Zambia's most compelling animal proteins story, since farmed fish is now more important than poultry in the national diet and looks to widen its lead. The first chapter of the story was a rapid surge in imports from a low base to nearly 80,000 tonnes of mostly frozen tilapia. The second chapter has been rapid development of domestic aquaculture thanks to international investment in cage farming and fish feed production in one concentrated area on Lake Kariba. The next chapter is currently being written, but it will be the launch of fish farming SMEs in the many regions of the country with sufficient water. Increasing know-how and developing supply chains for juvenile fish and aquafeed will underlie this expansion.

A key lesson is that protection of domestic industry via import tariffs or bans on products like farmed fish, frozen chicken and milk powder will only make both domestically produced animal proteins more expensive and lead to lower animal proteins consumption in the short and medium term. Such public policy propositions (related to advocating policies that will subsidise prices of products for consumers or reduce the costs of production for producers) begin to stray beyond the scope of this research. This report focuses on propositions related to what businesses can do to enhance the affordability of protein-rich foods through reducing production costs (to lower prices) or enhancing distribution channels (to lower costs to access).

Here we reflect on key takeaways from value chain mapping and consumer surveys to synthesis 'actionable propositions' for each value chain.

4.1 Poultry meat

Thanks to high feed conversion ratios for broilers in large commercial farms, chicken meat is generally one of the lowest cost sources of animal protein. Globally growth rates for chicken production in developing countries have far exceeded other livestock. Poultry account for 44 per cent of all compound feed consumption worldwide (Alltech, 2018). In Zambia SMEs now account for 30 and 65 per cent of layer and broiler production. Most birds from SMEs are sold live due to consumer preferences and cold storage considerations.

Increase distribution of inputs to new SMEs: Major producers of feed and day-old chicks could provide financing and technical support to increase the number of shops selling to small broiler farms in underserved areas. NGOs like Heifer International could be given greater support to expand their existing successful programmes to launch clusters of smallholder broiler farms with micro-credits and offer training in underserved areas. This could provide the critical mass to make such new distribution outlets feasible.

Expand out-grower schemes: Large poultry processors could guarantee off-take from new SMEs in underserved areas by guaranteeing off-take of mature birds when local markets fail.

Supply chain finance initiatives: In both broiler and layer value chains there are opportunities to close the working capital gap that appears between paying for inputs and receiving payments for outputs (explored in Section 3): establishing trade credit facilities, credit guarantee schemes or other financial arrangements have the potential to materially boost production.

Cold-chain distribution: Investment in cold chains in underserved areas will facilitate distribution of processed meat in smaller packages as well as separate sale of low-cost chicken parts like feet, wings and fifth quarter. Current average spending per purchase on chicken meat is relatively high because households in many underserved areas can only buy live birds.

4.2 Eggs

Egg production has been highly competitive and efficient with rapid expansion of layer farms more than keeping up with demand. Per egg retail prices averaging about $0.10 are low by international standards. Excess capacity at times has led to retrenchment and sharp reductions in the number of hens in lay has been necessary at times.

Feed costs: Soybean crushers could proactively educate SME layer farms in how to mix their own mash of soybean meal and maize grits. Larger layer farms achieve lower average feed costs by doing this while SMEs typically buy compound layer feed in pellet form at a higher cost.

Pullets for SMEs: Major producers of poultry feed and day-old chicks could extend financing and provide technical support to SME layer farms that would enable them to raise chicks to pullet stage (15 to 22 weeks old) at lower cost than buying point-of-lay hens.

Veterinary supplies: SMEs in the industry could collectively act to import some veterinary supplies to get lower costs. This is would prove challenging as veterinary importation is high regulated, so is likely to only be feasible with collective action rather than by individual SMEs. Most veterinary products used in Zambia are reimported from South African companies that are distributors and agents for global suppliers.

Egg processing: Large commercial egg producers could explore the production of easier to preserve eggs to enhance market reach and protect against seasonal variations. Eggs preserved in this manner could be distributed over wider areas and adapted by institutional users, catering and hospitality, and food processors. In times of excess production, demand from these producers would give layer farms an option to dump at low prices on the fresh market. At best it could mitigate the need to sharply reduce the number of hens in lay during overproduction cycles.

4.3 Dairy

In some low and middle income countries such as India, milk is the number one agricultural product by value with output increasing much more rapidly than the rate of population growth. In China milk powder is one of the largest food imports.

In Zambia greater production and consumption of dairy products in both rural and urban areas have significant potential to improve protein intake among lower income groups, particularly children. Some companies have invested in large-scale pasteurisation plants, but capacity use rates are still low. The reliable supply of raw milk at low prices to these plants must be increased so local production can compete with imported milk powder and become more affordable to lower income groups. Because a high percentage of households have their own cows, it is likely that the rural population consumes more milk on average than city dwellers. Therefore, the greatest need may be to make milk more affordable for poor people in urban areas.

Smallholder supply: It may be economically feasible for most large and medium dairy processors to incorporate into their raw milk supply chains newly organised cooperatives of smallholder dairy farmers supported by NGOs. For example, the largest dairy company in Zambia is the major multinational Parmalat. It is already cooperating in a Heifer International project that involves 100 village-level dairy cooperatives. Other large dairy processors rely on their own cows and other commercial dairy farms, but it is not clear whether they have entered into supply arrangements with village cooperatives. It should be noted that distance from bulk potential supply to pasteurisation plants remains an obstacle.

Premix supply: Large dairy processors could procure and supply at lower-cost vitamin and mineral premixes for cattle rearing to SMEs and village dairy cooperatives helping to reduce their production costs. Due to the long, multi-layered distribution chains, imported premixes are currently very costly to small dairy farmers who can only buy in small quantities

School feeding: Large commercial processors could develop products with special packaging for introduction into school-feeding programmes. This could include flavoured, vitamin and mineral-fortified yogurts as an effective vehicle for reducing micronutrient deficits.

Demand generation: An industry-wide campaign to create awareness of the benefits of milk consumption focusing on the importance of proteins could accompany an effort to extend packaged milk distribution into more underserved areas.

4.4 Beef

Zambia's beef industry is characterised by a dominant traditional segment that supplies nearly all beef consumed by the rural population, and a relatively small commercial market segment – at least in terms of cattle numbers – that serves the urban population. The two segments are not completely separate, with traditional herders supplying up to 20 per cent of the commercial market segment, which is growing rapidly. Demand from the rural population has been relatively stable over time.

Integration of traditional producers into commercial value chains: Commercial beef producers have the opportunity to expand their schemes, often supported by NGOs, to provide improved cattle to traditional herders as well as veterinary drugs and business training. Improvements in cattle genetics and health would make smallholder herds more suitable for fattening in feedlots through better feed conversion.

Establishment of small-scale feedlots: Once smallholder cattle breeds are better suited to them, cooperative arrangements for establishing more feedlots in rural areas could be feasible. Commercial producers could provide these feedlots under a number of possible lease type arrangements including rental payments, in-kind moveable asset payments and rent-to-own arrangements.

Infrastructure development for livestock agriculture: Extending public infrastructure (such as roads and feeder roads, electricity, storage and cold-chain facilities) through public investment to improve the supply of live cattle from traditional producers as well as the distribution of meat to low-income and underserved rural populations.

4.5 Fish

Wild capture and imported fish are both important protein sources in urban areas and in rural parts of several regions of Zambia. However, increasing wild capture is not sustainable. Substitution of frozen tilapia imports with domestic farmed fish would make the greatest contribution to economic development. Based on recent trends fish farming is one sector that shows high potential to increase the affordability and accessibility of animal source proteins to lower income groups in Zambia. In recent years at least four leading international players have made major investments in large-scale commercial fish feed production and fish farming operations. The African Development Bank has funded major projects through the Food and Agriculture Organization and the government to support the expansion of smallholders and SMEs in fish farming.

High protein soybean meal: Additional investment by Zambia's soybean crushing companies in the dehulling technology needed for high protein soybean meal production would permit the production of higher quality feed. For maximum conversion ratios and rapid growth, fish need feed with higher protein content (up to 70 per cent soybean meal) and less fibre than almost any other type of feed. Zambia has sufficient soybean production and solvent extraction capacity to meet this need. However, it is not clear whether all soybean extraction plants operating in the country have the needed dehulling equipment to produce the high protein soybean meal needed by fish feed producers.

Rural distribution channels: Fish feed and fingerling producers could support the creation of a network of agro-dealers/stockists to supply these key inputs to new small-scale local producers in underserved rural areas. Each shop could have trained staff to provide technical advice. Existing agro-dealers selling poultry inputs could be given financing and training to diversify into selling aquafeed, fingerlings and antibiotics. Larger stores in provincial capitals with reliable refrigeration and electricity could sell fish farming inputs and serve as off-takers for pond or lake-raised tilapia.

Outgrower schemes: Major aquaculture companies and food retailing chains could enter into expanded arrangements to provide regular off-take of pond or lake-raised tilapia from new clusters of smallholder and SME producers.

Aquaculture cooperatives: Where large enough clusters of smallholder and SME fish farmers are present, major aquaculture companies and food retailing chains could support their organisation into cooperative structures to facilitate both the supply of inputs and marketing of their output. NGOs could be enlisted to provide technical and legal support.

Privatisation of hatcheries: Privatisation or leasing of underused government hatcheries could help solve the deficit in fingerling supply and bring down their cost while reducing the level of undesirable in-pond breeding that reduces productivity.

Solar refrigeration: Large fish farming companies and their distributors could test the feasibility of solar refrigeration technology for ice making to support production and distribution-farmed fish in underserved areas off the power grid.

Fish promotion: An industry-based awareness campaign could promote consumption of farmed fish in areas where it is not a part of the traditional diet. There may be some regions of Zambia where fish farming is feasible and would provide a more affordable source of protein, but consumer education would be needed to change eating habits.

Overall, across all value chains, it is clear that higher incomes through economic growth coupled with lower prices and costs of access – through enhanced production and distribution approaches – present a coordinated way to enhance the affordability of protein-rich foods for low income and underserved households in Zambia.

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Annex 1: Demand-side analysis summary tables and figures

LOW INCOME

Table A1: Summary statistics by income group

STATISTIC		High income (HI)	Low income (LI)	Combined
Observations		271	734	1005.00
Total (K)		56,818	42,391	99,209
Market share (%)		57.3	42.7	-
Mean (K)		209.66	57.75	98.72
Standard deviation (SD) (K)		731.15	103.12	395.06
Minimum (K)		4	4	4
25th percentile (K)		21	16	19
Median (K)		40	28	30
Interquartile (IQ) range (K)		81	40	42
75th percentile (K)		102	56	61
90th percentile (K)		315	118	156
95th percentile (K)		950	200	300
99 percentile (K)		3,250	480	1134
Maximum (K)		8,878	1,200	8,878
Two sample Wilcoxon rank sum test	**rank sum**	156,571	348,944	505,515
	expected	136,313	369,202	505,515
	z			4.965
	P-value			0.0000

Table A2: Summary statistics on daily expenditure on different protein foods by income group

PRODUCT	INCOME BAND	Obs.	Weight	Total (ZMW; Zambia Kwacha)	Weighted total (ZMW)	MS; Market share (%)	Weighted MS (%)	Mean (ZMW)	SD (ZMW)	Minimum (ZMW)	25th percentile (ZMW)	Median (ZMW)	IQ range (ZMW)	75th percentile (ZMW)	90th percentile (ZMW)	95th percentile (MZW)	99th percentile (ZMW)	Maximum (ZMW)	Two sample Wilcoxon rank-sum test			
																			rank sum	expected	z	P-Value
BEEF	HI	140	3.4	24,777	84,596	59	78	177	371	5	30	50	110	140	475	764	2,000	3,000	42,184	33,530	6.312	0.0000
	LI	338	1.4	16,979	24,011	41	22	50	86	5	20	30	30	50	100	150	400	1,120	72,297	80,951		
	Combined	478		41,756	108,607	42	41	87	221	5	20	30	40	60	150	300	1,115	3,000	114,481	114,481		
CHICKEN	HI	73	3.5	18,264	64,299	71	86	250	975	10	25	50	95	120	370	1,000	8,100	8,100	11,942	9,417	4.709	0.0000
	LI	184	1.4	7,311	10,212	29	14	40	41	10	20	30	25	45	56	105	264	300	21,212	23,736		
	Combined	257		25,575	74,511	26	28	100	527	10	20	32	30	50	129	264	1,000	8,100	33,153	33,153		
EGGS	HI	23	2.2	3,807	8,442	68	72	166	571	15	27	29	5	32	60	400	2,760	2,760	915	828	1.072	0.2836
	LI	28	1.8	1,821	3,317	32	28	38	43	5	25.5	28	5.5	31	84	85	276	276	1,642	1,728		
	Combined	51		5,628	11,758	6	4	79	328	5	26	28	6	32	60	150	2,760	2,760	2,556	2,556		
DAIRY	HI	92	3.6	8,629	31,046	73	87	35	76	3	8.5	15	22	31	50	120	500	500	16,853	15,272	2.031	0.0422
	LI	239	1.4	3,259	4,514	27	13	36	115	4	5	12	15	20	50	150	500	1,200	38,093	39,674		
	Combined	331		11,888	35,559	12	13	36	106	3	7	14	16	23	50	150	500	1,200	54,946	54,946		
FISH	HI	55	4.0	3,924	15,553	41	67	71	142	5	20	35	30	50	150	250	1,000	1,000	7,052	6,023	2.554	0.0106
	LI	163	1.3	5,712	7,639	59	33	163	35	33.9	5	15	20	25	40	60	100	190	16,820	17,849		
	Combined	218		9,636	23,192	10	9	44	78	5	19	26	30	49	89	150	250	1,000	23,871	23,871		
PORK	HI	21	3.6	2,787	10,086	59	79	133	320	10	30	40	40	70	200	300	1,500	1,500	1,005	809	2.29	0.0220
	LI	55	1.4	1,940	2,681	41	21	35	20	5	22	30	20	42	62	70	120	120	1,921	2,118		
	Combined	76		4,727	12,767	5	5	62	172	5	24.5	32	26	50	70	120	1,500	1,500	2,926	2,926		
Total		1411		99,209	266,394																	

Table A3: Summary statistics on total daily expenditure on protein foods by district and income group

Province	District	INCOME BAND	Obs.	Weight	Total (ZMW: Zambia Kwacha)	Weighted total (ZMW)	MS: Market share (%)	Weighted MS (%)	Mean (ZMW)	SD (ZMW)	Minimum (ZMW)	25th percentile (ZMW)	Median (ZMW)	IQ range (ZMW)	75th percentile (ZMW)	90th percentile (ZMW)	95th percentile (MZW)	99th percentile (ZMW)	Maximum (ZMW)	Two sample Wilcoxon rank-sum test: rank sum	expected	z	P-Value
Central	Chisamba	HI	7	4.4	277	1,227	5	14	40	35	5	9	29	56	65	105	105	105	105	93	112	-0.898	0.3690
		LI	24	1.3	5,709	7,374	95	86	238	808	4	13	47	97	110	143	506	4,000	4,000	403	384		
		Combined	31	1.0	5,986	8,601	4	3	193	713	4	13	40	87	100	140	506	4,000	4,000	496	496		
	Kabwe	HI	14	2.9	809	2,311	44	59	67	73	10	19	32	71	90	195	229	229	229	272	234	1.195	0.2322
		LI	26	1.5	1,033	1,589	56	41	40	49	5	11	26	22	33	96	150	225	225	469	507		
		Combined	40	1.0	1,842	3,901	1	1	48	58	5	14	31	36	50	150	225	229	229	741	741		
	Kapiri	HI	4	4.8	930	4,418	54	82	233	406	23	24	33	417	441	841	841	841	841	45	40	0.451	0.6523
		LI	15	1.3	788	998	46	18	53	45	4	15	44	70	85	129	129	129	129	146	150		
		Combined	19	1.0	1,718	5,416	1	2	90	186	4	15	41	70	85	129	841	841	841	190	190		
Copperbelt	Chililabombwe	HI	38	3.8	30,898	117,900	69	86	813	1,585	5	50	215	800	850	2,680	3,250	8,878	8,878	3,548	2,774	3.481	0.0005
		LI	107	1.4	14,004	18,977	31	14	131	193	5	33	63	107	140	290	590	1,000	1,100	7,037	7,811		
		Combined	145	1.0	4,490	136,878	33	40	310	874	5	40	80	139	179	740	1,100	3,250	8,878	10,585	10,585		
	Mufulira	HI	25	4.4	1,764	7,762	31	61	71	77	9	20	40	57	77	218	220	300	300	1,716	1,388	2.342	0.0192
		LI	85	1.3	3,861	4,997	69	39	45	67	4	15	21	25	40	100	190	378	378	4,390	4,718		
		Combined	110	1.0	5,625	12,758	4	4	51	70	4	15	25	33	48	125	220	300	378	6,105	6,105		
	Ndola	HI	19	3.0	1,106	3,318	43	60	58	97	4	11	21	29	40	276	360	360	360	496	551	-0.940	0.3470
		LI	38	1.5	1,481	2,222	57	40	39	34	4	20	26	20	40	100	100	182	182	1,158	1,102		
		Combined	57	1.0	2,587	5,540	2	2	45	62	4	19	25	21	40	100	182	360	360	1,653	1,653		
Eastern	Chipata	HI	18	1.2	2,855	3,331	58	19	714	1,364	20	23	38	1,383	1,405	2,760	2,760	2,760	2,760	201	144	1.425	0.1542
		LI	3	7.0	2,056	14,392	42	81	31	39	4	15	25	20	35	49	61	321	321	2,355	2,412		
		Combined	21	1.0	4,911	17,723	4	5	69	326	4	15	25	21	36	49	62	2,760	2,760	2,556	2,556		
	Petauke	HI	1	36.0	5	180	1	19	5	-	5	5	5	0	5	5	5	5	5	2	19	-1.638	0.1013
		LI	35	1.0	761	783	99	81	22	12	5	12	20	16	28	38	52	54	54	665	648		
		Combined	36	1.0	766	963	1	0	21	12	5	12	19	16	28	38	52	54	54	666	666		
Luapula	Mansa	HI	2	37.5	35	1,313	1	26	18	12	9	9	18	17	26	26	26	26	26	48	76	-0.922	0.3566
		LI	73	1.0	3,609	3,708	99	74	49	60	4	14	25	45	59	107	186	300	300	2,802	2,774		
		Combined	75	1.0	3,644	5,020	3	1	49	59	4	14	25	45	59	107	186	300	300	2,850	2,850		

Table A3 (continued)

Province	District	INCOME BAND	Obs.	Weight	Total (ZMW: Zambia Kwacha)	Weighted total (ZMW)	MS: Market share (%)	Weighted MS (%)	Mean (ZMW)	SD (ZMW)	Minimum (ZMW)	25th percentile (ZMW)	Median (ZMW)	IQ range (ZMW)	75th percentile (ZMW)	90th percentile (ZMW)	95th percentile (MZW)	99th percentile (ZMW)	Maximum (ZMW)	Two sample Wilcoxon rank-sum test			
																				rank sum	expected	z	P-Value
Lusaka	Lusaka	HI	89	2.9	21,099.5	60,454	48	63	237	642	4	30	70	170	200	500	1,025	5,500	5,500	13,202	11,392	3.226	0.0013
		LI	166	1.5	23,022	35,365	52	37	139	575	4	21	41	75	96	200	370	1,850	7,000	19,438	21,248		
		Combined	255	1.0	44,121.5	95,819	32	28	173	600	4	24	50	91	115	270	521	1,850	7,000	32,640	32,640		
Muchinga	Mpika	HI	33	3.3	1,517	4,965	36	56	46	55	5	15	30	30	45	100	200	200	200	1,774	1,799	-0.167	0.8674
		LI	75	1.4	2,742	3,948	64	44	37	32	3	15	29	30	45	76	100	170	170	4,113	4,088		
		Combined	108	1.0	4,259	8,913	3	3	39	40	3	15	29	30	45	95	103	200	200	5,886	5,886		
North-Western	Solwezi	HI	17	4.1	1,076	4,431	28	54	63	56	4	25	50	44	69	160	178	178	178	764	604	2.200	0.0278
		LI	53	1.3	2,825	3,731	72	46	53	164	4	12	20	28	40	73	127	1,200	1,200	1,721	1,882		
		Combined	70	1.0	3,901	8,162	3	2	56	145	4	12	25	33	45	116	160	1,200	1,200	2,485	2,485		
Northern	Kasama	HI	9	7.3	1,285	9,423	29	72	143	341	10	10	40	40	50	1,052	1,052	1,052	1,052	290	302	-0.225	0.8223
		LI	57	1.2	3,197	3,702	71	28	56	93	5	13	31	42	55	107	200	600	600	1,922	1,910		
		Combined	66	1.0	4,482	13,125	3	4	68	151	5	13	32	42	55	107	200	1,052	1,052	2,211	2,211		
Southern	Choma	HI	12	3.2	1,027	3,252	50	69	86	78	4	40	57	71	111	160	288	288	288	306	234	2.264	0.0236
		LI	26	1.5	1,020	1,491	50	31	39	30	4	20	30	30	50	84	100	105	105	435	507		
		Combined	38	1.0	2,047	4,743	1	1	54	54	4	20	38	60	80	105	160	288	288	741	741		
	Mazabuka	HI	15	3.1	1,057	3,241	53	70	70	67	8	29	54	56	85	197	247	247	247	452	353	2.339	0.0193
		LI	31	1.5	954	1,416	47	30	31	20	4	16	26	32	48	65	65	65	65	629	729		
		Combined	46	1.0	2,011	4,657	1	1	44	45	4	16	31	49	65	65	95	247	247	1,081	1,081		
	Monze	HI	16	2.7	1,038	2,790	49	62	65	97	8	24	30	28	52	169	400	400	400	403	152	1.283	0.1996
		LI	27	1.6	1,066	1,698	51	38	39	55	4	15	26	23	38	73	95	294	294	543	594		
		Combined	43	1.0	2,104	4,487	2	1	49	73	4	16	27	29	45	78	169	400	400	946	946		
Western	Kaoma	HI	3	10.3	127	1,312	11	53	42	43	10	10	26	81	91	91	91	91	91	54	48	0.406	0.6847
		LI	28	1.1	1,067	1,181	89	47	38	73	10	19	20	11	30	50	85	400	400	442	448		
		Combined	31	1.0	1,194	2,494	1	1	39	70	10	19	20	11	30	50	91	400	400	496	496		
	Mongu	HI	4	8.8	130	1,138	9	45	33	13	20	25	30	15	40	50	50	50	50	83	72	0.572	0.5675
		LI	31	1.1	1,242	1,402	91	55	40	43	4	13	28	32	45	93	130	200	200	547	558		
		Combined	35	1.0	1,372	2,540	1	1	39	40	4	15	28	30	45	93	130	200	200	630	630		
Total			1226		137,473	341,738																	

Table A4: Pairwise correlation (PC) matrix of daily expenditure on protein foods by low income consumer attribute

Variable		Average weekly expenditure on protein						
		Total expenditure	Beef	Chicken	Eggs	Dairy	Fish	Pork
Beef	**PC**	0.6640	1.0000					
	Sig.	0.0000						
Chicken	**PC**	0.7607	0.7486	1.0000				
	Sig.	0.0000	0.0000					
Eggs	**PC**	0.3288	0.0233	0.1293	1.0000			
	Sig.	0.0225	0.9161	0.6333				
Dairy	**PC**	0.8368	0.4248	0.6206	0.0121	1.0000		
	Sig.	0.0000	0.0002	0.0000	0.9644			
Fish	**PC**	0.5607	0.5661	0.2296	-0.0001	0.5949	1.0000	
	Sig.	0.0000	0.0000	0.1386	0.9998	0.0022		
Pork	**PC**	0.3979	0.3970	0.5871	-0.3736	-0.0417	0.7771	1.0000
	Sig.	0.0026	0.0446	0.0168	0.4657	0.9030	0.0049	
Monthly income	**PC**	-0.0163	0.0846	0.1080	0.0331	0.0802	0.1780	0.0657
	Sig.	0.6129	0.1206	0.1446	0.8235	0.2169	0.0230	0.6337
Weekly food expenditure average	**PC**	-0.0088	-0.0429	-0.0405	-0.1633	-0.0136	-0.1268	0.1508
	Sig.	0.7871	0.4341	0.5894	0.2782	0.8365	0.1102	0.2719
Distance (km)	**PC**	0.0003	0.0173	-0.0216	0.2471	-0.0180	-0.0822	-0.0534
	Sig.	0.9919	0.7506	0.7712	0.0904	0.7823	0.2970	0.6987
Time	**PC**	0.0034	0.1024	0.1036	0.2768	0.0829	0.0287	-0.0022
	Sig.	0.9160	0.0601	0.1618	0.0568	0.2017	0.7164	0.9873
Household seize	**PC**	0.0755	0.1430	0.0101	-0.0503	0.0946	-0.1418	-0.0246
	Sig.	0.0191	0.0085	0.8916	0.7344	0.1450	0.0709	0.8583
Refrigerator access	**PC**	0.0770	0.1362	0.2099	-0.1131	-0.0327	0.2527	0.1290
	Sig.	0.0167	0.0122	0.0042	0.4439	0.6146	0.0011	0.3478
Age household head	**PC**	-0.0036	0.0812	0.1006	-0.2382	0.0361	-0.1057	-0.0021
	Sig.	0.9110	0.1362	0.1744	0.1031	0.5786	0.1794	0.9881
Gender (male)	**PC**	-0.0242	0.0917	0.0711	0.2150	0.1177	0.0278	0.0246
	Sig.	0.4526	0.0924	0.3375	0.1422	0.0694	0.7249	0.8586
Employed	**PC**	0.0416	0.0635	0.0579	0.1423	0.0392	0.1200	0.0751
	Sig.	0.1967	0.2445	0.4353	0.3345	0.5466	0.1271	0.5856
Modern cooking energy	**PC**	0.0352	0.0624	0.1643	0.2213	-0.1279	0.1727	0.0191
	Sig.	0.2743	0.2523	0.0258	0.1307	0.0482	0.0275	0.8897

Table A4 (continued):

Variable		Average weekly expenditure on protein						
		Total expenditure	Beef	Chicken	Eggs	Dairy	Fish	Pork
Local market	**PC**	-0.0015	-0.0209	0.0607	-0.2164	-0.0310	0.0132	-0.2340
	Sig.	0.9617	0.7013	0.4128	0.1396	0.6330	0.8672	0.0855
Local butchery	**PC**	0.0115	0.0096	0.0924	-0.0753	-	0.1095	0.0744
	Sig.	0.7203	0.8606	0.2122	0.6111	-	0.1640	0.5893
Pick N Pay	**PC**	0.0379	-	-	0.0753	0.0924	0.2676	-
	Sig.	0.2395	-	-	0.6112	0.1544	0.0006	-
Halaal butchery	**PC**	-0.0075	-0.0356	0.0184	-	-	-0.0117	-
	Sig.	0.8165	0.5138	0.8038	-	-	0.8818	-
Shoprite	**PC**	0.0177	0.0223	0.0005	-0.0305	0.0078	-	-
	Sig.	0.5821	0.6831	0.9949	0.8370	0.9041	-	-
Quick Save	**PC**	-0.0034	-0.0103	-	-	-	-	0.2352
	Sig.	0.9149	0.8499	-	-	-	-	0.0839
Yalelo Fish	**PC**	-0.0061	-	-	-	-	0.1736	-
	Sig.	0.8500	-	-	-	-	0.0267	-
Lake Harvest	**PC**	0.0098	0.0316	-	-	0.0078	0.1554	-
	Sig.	0.7610	0.5624	-	-	0.9041	0.0477	-
Zambeef	**PC**	-0.0009	0.0077	-0.1140	0.1915	-0.0134	-0.2378	0.1297
	Sig.	0.9787	0.8884	0.1233	0.1922	0.8368	0.0022	0.3451
Shops most days of the week	**PC**	0.0267	0.0367	0.0791	-0.2016	0.0768	-0.1158	-0.3141
	Sig.	0.4078	0.5018	0.2856	0.1693	0.2367	0.1410	0.0195
Shops 2 to 3 times a week	**PC**	-0.0587	-0.1033	-0.0473	0.0940	-0.0999	-0.0234	0.2013
	Sig.	0.0685	0.0577	0.5237	0.5249	0.1233	0.7669	0.1405
Shops once a week	**PC**	0.0200	-0.0386	-0.1101	0.0751	-0.0022	0.1193	0.0769
	Sig.	0.5349	0.4790	0.1367	0.6117	0.9730	0.1293	0.5768
Shops once a month	**PC**	0.0343	0.1816	0.1307	0.1110	-0.0397	-0.0267	0.1203
	Sig.	0.2867	0.0008	0.0771	0.4525	0.5413	0.7355	0.3813
Shops occasionaly	**PC**	0.0249	0.1423	0.1323	0.1110	-0.0364	-0.0151	-0.0220
	Sig.	0.4401	0.0088	0.0733	0.4525	0.5758	0.8482	0.8735
Produces own meat and poultry	**PC**	-0.0220	-0.0462	-0.0053	-0.0639	-0.0006	0.1315	0.1155
	Sig.	0.5686	0.4604	0.9515	0.7113	0.9939	0.1770	0.4962
Produces own eggs and dairy	**PC**	-0.0242	0.0001	-0.0004	-	-0.0272	-	-0.1048
	Sig.	0.6016	0.9993	0.9969	-	0.7424	-	0.6343
Produces own fish	**PC**	-0.0151	-	-	0.1728	-0.0004	-0.0346	-
	Sig.	0.7084	-	-	0.3210	0.9958	0.6901	-
Produces own fish	**PC**	-0.0598	-0.0189	-0.1163	-0.1954	-0.0871	-0.0759	0.0729
	Sig.	0.0912	0.7550	0.1457	0.2397	0.2187	0.3906	0.6548
Eats meat most days of the week	**PC**	-0.0127	-0.0232	0.0387	-0.0872	0.0016	0.0906	-0.0432
	Sig.	0.6931	0.6706	0.6019	0.5555	0.9808	0.2501	0.7542
Eats meat 2 to 3 times a week	**PC**	-0.0007	-0.0625	0.1072	0.1265	-0.0433	0.1253	0.1478
	Sig.	0.9836	0.2520	0.1477	0.3916	0.5053	0.1109	0.2817
Eats meat once a week	**PC**	0.0096	0.0079	-0.1184	0.0267	-0.0405	-0.1457	-0.1657
	Sig.	0.7655	0.8852	0.1095	0.8569	0.3529	0.0635	0.2268
Eats meat once a month	**PC**	0.0132	0.1559	0.0714	-0.0379	0.0540	-0.0222	0.1742
	Sig.	0.6833	0.0041	0.3352	0.7983	0.4058	0.7788	0.2033
Eats meat occasionally	**PC**	-0.0262	-0.0277	-0.0818	-0.0745	-0.0384	-0.0889	-0.0268
	Sig.	0.4170	0.6114	0.2696	0.6150	0.5546	0.2590	0.8460
Does not eat meat	**PC**	0.0219	0.0623	-0.0312	-0.1124	0.2717	0.0233	-
	Sig.	0.4974	0.2535	0.6746	0.4471	0.0000	0.7677	-

Table A5: Summary statistics by population

STATISTIC		Served (SV)	Underserved (UV)	Combined
Obs.		964	309	1,273
Weight		1.3	4.1	1
Total (K)		66,276	14,355	80,631
Weighted total (K)		87,520	59,139	146,659
Market share (%)		82.2	17.8	-
Weighted market share (%)		59.7	40.3	-
Mean (K)		68.75	46.46	63.34
Standard deviation (SD) (K)		73.85	41.79	68.15
Minimum (K)		0	0	0
25th percentile (K)		25	12.00	20.00
Median (K)		55	39	50
IQ range (K)		65	58	65
75th percentile (K)		90	70	85
90th percentile (K)		140	105	130
95th percentile (K)		180	130.00	160.00
99 percentile (K)		350	190	300
Maximum (K)		1,000	200	1000.00
Two sample Wilcoxon rank sum test	**rank sum**	642,312	168,589	810,901
	expected	614,068	196,833	810,901
	z			5.036
	P-value			0.0000

Table A6: Summary statistics on total weekly expenditure on protein foods by district and population

Province	Treatment District	Obs.	Weight	Total (K)	Weighted (K)	Provincial (weighted K)	Market share (%)	Weighted market share (%)	Mean (K)	SD (K)	Minimum (K)	25th percentile (K)	Median (K)	IQ range (K)	75th percentile (K)	90th percentile (K)	95th percentile (K)	99 percentile (K)	Maximum (K)	Two sample Wilcoxon rank-sum test			
																				rank sum	expected	z	P-value
CENTRAL	Chisamba SV	24	1.7	1,477	2,523		58	50	62	35	0	40	62	52	92	108	110	113	113	503	504		
	Chibombo UV	17	2.4	1,052	2,537		42	50	62	35	0	35	65	50	85	106	118	118	118	358	357	-0.027	0.9789
	Combined	41	15.2	2,529	5,060	38,490	7	11	62	35	0	40	65	50	90	108	110	118	118	861	861		
COPPERBELT	Chililabombwe SV	107	1.1	10,296	11,739		92	60	96	119	0	35	65	86	121	170	265	580	1,000	6,713	6,581		
	Chililabombwe UV	15	8.1	955	7767		8	40	64	50	0	40	50	40	80	155	190	190	190	790	923	1.034	0.3011
	Combined	122	5.1	11,251	19,507	57,546	29	17	92	113	0	40	61	70	110	160	250	580	1,000	7,503	7,503		
EASTERN	Petauke SV	35	1.3	2,694	3,618		83	62	77	49	20	45	70	55	100	150	195	230	230	928	840		
	Luangwa UV	12	3.9	557	2,182		17	38	46	28	10	31	37	24	55	85	112	112	112	201	288	2.136	0.0327
	Combined	47	13.3	3,251	5,799	43,162	8	13	69	47	10	35	52	50	85	115	180	230	230	1,128	1,128		
LUAPULA	Mansa SV	73	1.2	5,902	7,196		85	55	81	59	15	35	65	80	115	150	180	314	314	3,381	3,285		
	Mwense UV	16	5.6	1,038	5,774		15	45	65	48	5	21	60	73	94	150	155	155	155	625	720	1.021	0.3073
	Combined	89	7.0	6,940	12,969	48,658	18	14	78	58	5	35	65	75	110	150	180	314	314	4,005	4,005		
MUCHINGA	Mpika SV	75	1.3	3,272	4,145		73	42	44	60	0	0	27	60	60	128	200	300	300	3,423	3,600		
	Shiwangandu UV	20	4.8	1,182	5,615		27	58	59	60	0	14	53	49	63	165	200	200	200	1,138	960	-1.645	0.1000
	Combined	95	6.6	4,454	9,759	29,256	11	9	47	60	0	0	30	60	60	130	200	300	300	4,560	4,560		
NORTH WESTERN	Solwezi SV	53	1.3	2,251	3,015		80	58	42	49	0	0	28	65	65	100	150	189	189	1,929	1,908		
	Mufumbwe UV	18	3.9	565	2,229		20	42	31	32	0	8	20	42	50	88	100	100	100	628	648	0.277	0.7816
	Combined	71	8.8	2,816	5,244	24,749	7	7	40	45	0	0	25	65	65	100	150	189	189	2,556	2,556		
NORTHERN	Kasama SV	57	1.3	1,138	1,457		88	68	20	31	0	0	0	32	32	65	85	150	150	2,173	2,109		
	Mbala UV	16	4.6	150	684		12	32	9	14	0	0	0	30	30	30	30	30	30	528	592	0.976	0.3292
	Combined	73	8.5	1,288	2,142	11,010	3	3	18	29	0	0	0	30	30	55	70	150	150	2,701	2,701		
SOUTHERN	Choma SV	26	1.7	2,260	3,912		63	55	87	37	28	58	86	54	112	128	133	180	180	665	598		
	Kalomo UV	19	2.4	1,342	3,178		37	45	71	22	32	55	70	31	86	105	109	109	109	371	437	1.529	0.1262
	Combined	45	13.9	3,602	7,090	49,948	9	15	80	32	28	55	80	46	101	124	128	180	180	1,035	1,035		
WESTERN	Mongu SV	31	1.3	2,181	2,885		83	61	70	69	0	36	53	45	81	100	191	378	378	696	651		
	Senanga UV	10	4.1	458	1,878		17	39	46	41	8	10	36	53	63	115	130	130	130	166	210	1.353	0.1760
	Combined	41	15.2	2,639	4,762	40,164	7	12	64	64	0	30	50	48	78	100	138	378	378	861	861		
	TOTAL	230		10,345	19,238	125,871																	

Table A7: Pairwise correlation matrix of weekly expenditure on protein foods by underserved consumer attribute

		Average weekly expenditure on protein				
Variable	Stat	Aggregate expenditure	Meat and poultry	Eggs and dairy	Fish	Cereal
Total expenditure on protein food	**PC**	1.0000				
Meat and poultry (weekly amount)	**PC**	0.6733	1.0000			
	Sig.	0.0000				
Eggs and dairy	**PC**	0.6075	0.4046	1.0000		
	Sig.	0.0000	0.0000			
Fish	**PC**	0.6969	0.4191	0.4701	1.0000	
	Sig.	0.0000	0.0000	0.0000		
Cereal	**PC**	0.6531	0.2365	0.1087	0.2294	1.0000
	Sig.	0.0000	0.0004	0.1408	0.0003	
Income	**PC**	0.4366	0.3586	0.2447	0.2695	0.1280
	Sig.	0.0000	0.0000	0.0008	0.0000	0.0296
Weekly food expenditure average	**PC**	0.3761	0.1634	0.1234	0.2772	0.1900
	Sig.	0.0000	0.0133	0.0952	0.0000	0.0012
Distance (KM)	**PC**	0.0739	0.0333	-0.0192	0.0050	0.0198
	Sig.	0.1777	0.6080	0.7922	0.9363	0.7323
Time	**PC**	0.0581	0.0266	-0.0304	0.0227	0.0397
	Sig.	0.2900	0.6814	0.6767	0.7185	0.4918
Household seize	**PC**	0.1595	0.0615	0.0927	0.1251	0.0889
	Sig.	0.0035	0.3426	0.2023	0.0465	0.1231
Refrigerator access	**PC**	0.3136	0.0801	0.0207	0.1787	0.1790
	Sig.	0.0000	0.2164	0.7757	0.0043	0.0018
Region (rural)	**PC**	0.0516	0.0834	-0.0122	-0.0450	-0.0829
	Sig.	0.3467	0.1978	0.8673	0.4755	0.1506
Age household head	**PC**	-0.1470	-0.0449	-0.0344	-0.0349	-0.1053
	Sig.	0.0071	0.4890	0.6369	0.5800	0.0677
Gender (male)	**PC**	0.0619	0.0147	0.1569	0.0347	0.0824
	Sig.	0.2593	0.8210	0.0302	0.5822	0.1530
Employed	**PC**	0.1714	0.0838	0.0892	0.0276	0.1215
	Sig.	0.0017	0.1958	0.2196	0.6616	0.0349
Modern cooking energy	**PC**	0.1346	0.0646	-0.0366	0.0983	0.0007
	Sig.	0.0138	0.3186	0.6155	0.1180	0.9906

Table A7 (continued)

Variable	Stat	Average weekly expenditure on protein				
		Aggregate expenditure	Meat and poultry	Eggs and dairy	Fish	Cereal
Buys from Zambeef	**PC**	0.4577	0.1117	0.2366	0.2763	0.2686
	Sig.	0.0000	0.0842	0.0010	0.0000	0.0000
Agricultural income	**PC**	-0.0419	-0.0410	-0.0250	-0.0199	-0.0600
	Sig.	0.4458	0.5275	0.7318	0.7527	0.2987
Shops from local vendors	**PC**	-0.0355	-0.2184	-0.1690	-0.0808	0.0365
	Sig.	0.5179	0.0007	0.0195	0.1995	0.5280
Shops from local market	**PC**	0.1425	0.1084	0.1388	0.1292	0.1691
	Sig.	0.0091	0.0940	0.0555	0.0396	0.0032
Shops from local store	**PC**	0.0654	0.0484	0.0096	-0.0214	0.0859
	Sig.	0.2332	0.4555	0.8955	0.7348	0.1365
Shops out of town	**PC**	0.2395	0.1547	0.0476	0.0663	0.1793
	Sig.	0.0000	0.0165	0.5130	0.2925	0.0018
Produces own food	**PC**	0.0022	-0.0242	.	0.1539	-0.0750
	Sig.	0.9677	0.7096	.	0.0141	0.1935
Purchases from Shoprite	**PC**	0.0342	0.0905	0.0388	-0.0116	-0.0648
	Sig.	0.5336	0.1624	0.5944	0.8542	0.2619
Eats meat on most days	**PC**	0.1204	-0.0209	0.2386	0.0711	0.0467
	Sig.	0.0278	0.7479	0.0009	0.2588	0.4185
Eats meat 2–3 times a week	**PC**	0.3433	0.3438	0.2285	0.1565	0.1279
	Sig.	0.0000	0.0000	0.0015	0.0125	0.0263
Eats meat once a week	**PC**	0.0715	-0.0305	-0.1363	-0.0066	0.0159
	Sig.	0.1923	0.6387	0.0601	0.9171	0.7826
Eats meat once a month	**PC**	-0.1528	-0.2065	-0.1094	-0.0724	0.0536
	Sig.	0.0051	0.0013	0.1320	0.2504	0.3532
Eats meats occasionally	**PC**	-0.2180	-0.2337	-0.0850	-0.1004	-0.1437
	Sig.	0.0001	0.0003	0.2424	0.1103	0.0124
Never eats meat	**PC**	-0.2522	-0.0172	-0.1441	-0.0859	-0.1268
	Sig.	0.0000	0.7914	0.0468	0.1725	0.0276

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