

Livestock
Data
Innovation
in Africa



BUSINESS AND LIVELIHOODS IN AFRICAN LIVESTOCK

Investments to overcome information gaps



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EXECUTIVE SUMMARY

Poverty is widespread in Africa, but the continent is fast growing, with the consumption of animal protein skyrocketing, in particular for relatively low-value, low-processed livestock products. Meanwhile, in rural areas, the majority of households are livestock keepers, many of whom are poor. This growth in demand for animal protein can provide major business opportunities for livestock producers, with implications for poverty reduction.

While there is heterogeneity among livestock keepers, clustering them into homogenous groups is useful to guide policy and investment decisions that stimulate a market-driven and inclusive growth of the sector. A small share of livestock keepers, from between 5 to 20 percent, depending on the country, can be considered business-oriented with incentives to expand their livestock production and tap into the growing market for animal protein. These keep large herds and derive a significant share of their cash income from accessing and utilizing livestock markets. The remainder of livestock keepers can be defined as livelihood-oriented: they keep animals more for the many livelihoods services they provide — such as insurance, manure and hauling services — than for selling meat, milk and other livestock products to the market. The reason is simple: on average, they keep 1.60 Tropical Livestock Units (TLUs), which is equivalent to about three beef cattle per household or about 0.6 TLU per household member, and, therefore, they cannot derive large benefits from regularly selling their surplus production to the market.

Policies and investments aimed at enhancing the contribution of livestock to economic growth and poverty reduction should consequently adopt a dual strategy of targeting livelihood-oriented and business-oriented livestock keepers, who have diverse incentives to keep animals. There are, however, major information gaps which constrain the formulation of effective policy and investment decisions.

First, basic information on livelihood-oriented livestock keepers is typically unavailable at the national level, largely because livestock is under-represented in statistical operations. This information is needed not so much to understand household's

“Policies and investments aimed at enhancing the contribution of livestock to economic growth and poverty reduction should target both livelihood-oriented and business-oriented livestock keepers.”

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“The information collected through surveys is essential to design policies and investments that assist business-oriented livestock keepers to increase the productivity of their animals.”

husbandry practices and production constraints, which are known to a large extent, but rather to measure the contribution of livestock to their livelihoods and, hence, to understand the potential returns from livestock investments on their livelihoods, and their willingness to invest in their animals. This is a key piece of information which feeds into the design of policies and investments aimed at ensuring that livelihood-oriented livestock keepers derive maximum benefits from their animals. Consequently, governments are recommended to adequately include livestock in national statistical surveys.

Second, even when data on livestock are collected, these are insufficient to characterize business-oriented livestock keepers. Indeed, the typical statistical system neglects small groups and, as said, business-oriented livestock keepers are few in numbers. There is also heterogeneity among them, as some could be dairy specialists while others are broiler producers. Thus the characterization of specific segments of business-oriented livestock producers, needed for policy and investment purposes, is *de facto* impossible with currently available data. Consequently, governments are recommended to undertake livestock surveys specifically targeting business-oriented livestock keepers. The primary objective of these surveys is not to understand the incentives these households have to invest in their animals — the incentives are there — but to understand in detail their production practices: how many animals are kept in these systems, what are the prevailing breeding and feeding practices, etc. This information is essential to design policies and investments that assist business-oriented livestock keepers to increase the productivity of their animals. It also provides guidance to help livelihood-oriented livestock keepers become more business-oriented, thereby using their animals as a tool for exiting poverty.

Third, available household or farm level data — for both livelihood-oriented and business-oriented livestock keepers — are insufficient to appreciate the root causes of productivity constraints and current limited access to input and output markets. For example, available data that reveal that animal diseases and access to feed are major constraints to productivity do not inform decision makers on how the prevalence of selected animal diseases can be reduced or how the use of supplemental feed can be promoted. Governments are recommended to adopt supply chain approaches to reveal livestock productivity and market access constraints, focusing not only on farmers — as is often the case — but also on other actors along the supply chains, such as drug and feed producers and distributors, and traders and processors. These actors sell inputs and services to and purchase products from livestock keepers. Information on them, therefore, would allow governments to design policies and investments that help input suppliers, traders, processors and other actors develop business models that are inclusive of both livelihood-oriented livestock keepers — as buyers of livestock inputs — and business-oriented livestock keepers — as buyers of inputs and suppliers of livestock products. This is essential for growth of livestock, which ultimately is a private business.

Governments, regional institutions and the international community should jointly collaborate to collect and systemize critical livestock information to refine the proposed livestock for livelihoods and livestock for business development agenda. Policies and investments need to be reviewed within this development paradigm, thereby promoting sustainable growth of a sector which holds much potential for pro-poor development and economic growth, and one which can play a critical role in responding to anticipated food demand in Africa.

1. INTRODUCTION

Poverty is widespread in Africa. The proportion of people living on less than US\$ 1.25 per day — which defines the extremely poor — ranges from less than 5 percent in North African countries to over 80 percent in some sub-Saharan economies, such as Burundi, Chad and Madagascar. In 37 out of the 47 African countries for which poverty data are available, more than one-fourth of the population lives in extreme poverty; in 16 countries, more than half of the population lives on less than US\$ 1.25 per day¹. Poverty is largely a rural phenomenon, with three-quarters of the extremely poor estimated to live in rural areas, at least in sub-Saharan Africa². In most cases these are farm households, the majority of which keep some farm animals, ranging from poultry through sheep and goats to cattle³.

Yet **Africa is growing fast.** While aggregate economic growth in Africa grew little in the 1980s and the early 1990s, over the second half of the 1990s to the first decade of the new millennium economic growth averaged about 5 percent per year, or 2.5 percent on a per capita basis. By 2010, Africa's per capita income had grown 46 percent from its 1995 level. Adverse shocks, including the global economic recession in 2009 and the 'Arab Spring' in 2011, negatively impacted on Africa's growth rate. But, by 2013 the continent regained its momentum and returned to the economic 'fast track', with local economies maintaining their 5 percent growth patterns⁴. Such positive economic performances are attracting global interest and generating lucrative business opportunities, as highlighted by recent media coverage on Africa⁵⁻⁸.

African emergence – the rise of the phoenix

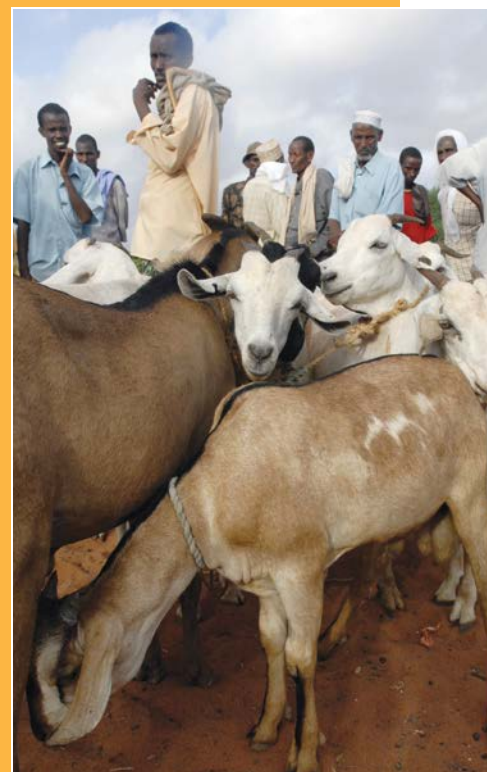
The Dynamic African Consumer Market:
Exploring Growth Opportunities in sub-Saharan Africa

Lions on the move: the progress and
potential of African economies

Cracking the next growth market: Africa

“Poverty is a largely rural phenomenon, with the majority of (farm) households keeping livestock.”

©FAO/Ami Vitale



“It is increasingly recognized that growth of agriculture and agribusiness, including the livestock industry, is key to reducing poverty.”

Agriculture and agribusiness, including livestock, have been among the fastest growing sectors since the 1990s, and the growing demand for food, and high value agricultural products such as meat and dairy in particular, is setting the stage for continued opportunities for investment. By 2030, the value of agriculture and agribusiness industries in sub-Saharan Africa is projected to reach US\$ 1 trillion, compared to US\$ 313 billion in 2010⁹, of which a non-marginal share will come from the livestock sector. Indeed, given the current consumption trends in animal protein, the livestock sector, which nowadays accounts for almost one-third of the value added of African agriculture, is anticipated to become one of the main, if not the largest, contributors to agriculture in the coming decades. By way of comparison, in industrialized countries, livestock accounts for between 50 and 60 percent of the agricultural value added¹⁰.

It is increasingly recognized that growth of agriculture and agribusiness, including the livestock industry, is key to reducing poverty. A large share of Africa's poor is made up of smallholder farmers, the majority of which keep animals. Increased livestock productivity can improve the livelihoods of these producers; higher production also translates into lower food prices, to the clear benefit of the majority of households who are buyers of animal protein. In addition, investments in livestock productivity fuel the development of agro-industries and value chains that generate employment as an alternative to farming¹¹⁻¹⁶.

This paper investigates how the development of the livestock sector can contribute to economic growth and poverty reduction in the continent, with the ultimate objective of identifying major information gaps critical to designing and implementing successful livestock sector policies and investments.

Evidence-based arguments using nationally representative data collected by governments are derived, which allow country-relevant conclusions on possible development trajectories for the livestock sector. The document avoids *ad hoc* studies which, although valuable, are not necessarily appropriate for broad investment and policy guidance. Most of the arguments build on data from settled rural households in seven countries, including Ghana, Madagascar, Malawi, Niger, Nigeria, Tanzania and Uganda¹⁷⁻²³. The data were collected in different years but present high degrees of comparability in codification and nomenclatures: analyses reveal significant consistency across countries, which is suggestive of broad common patterns and trends in the continent²⁴⁻²⁷. However, the conclusions derived are neither automatically valid for the entire African continent nor for pastoral populations.

As a first step, the paper presents an analysis of African consumption of animal-source foods. This is rapidly growing and is forecast to continue doing so. It therefore provides opportunities for demand-led growth. This focus is distinct from the more traditional, production-oriented entry point. To understand opportunities for poverty reduction, this paper reviews both the quantitative and

qualitative dimensions of African markets for livestock products, in this case animal-source foods.

Second, rather than exploring production and productivity constraints, which are known to a large extent, **the paper focuses on the incentives that rural households have to invest in their livestock** to overcome those constraints. Indeed, farmers often fail to adopt readily available technologies. To analyze incentives, the paper reviews two intertwined dimensions of households' livestock activities, namely **herd/flock size** and **livestock-derived income**.

The paper concludes by identifying investment priorities for improving the quantity and quality of livestock information so that decision makers will be better able to formulate and implement investments in the livestock sector that effectively contribute to economic growth and poverty reduction.

“A priority: improving the quantity and quality of livestock information for investment planning.”

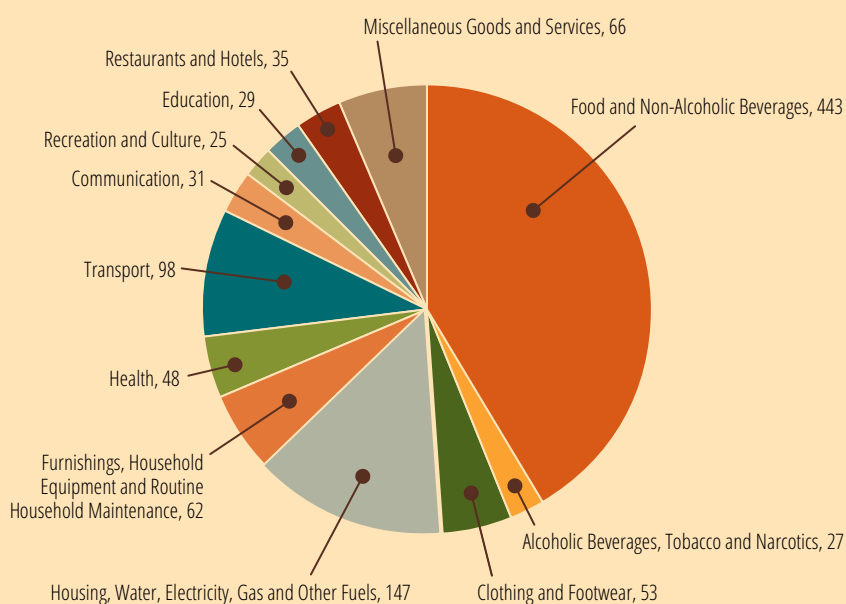
2. AFRICAN LIVESTOCK MARKETS

Emerging Business Opportunities

Over 1 billion African consumers are either extremely poor or poor, living on less than US\$ 1.25 and US\$ 2 a day, respectively. The extremely poor and the poor spend a large, often the largest, share of their budget on food. The typical African household allocates more than 40 percent of its budget to food products: this translates into the share of the **food economy in Africa, valued at US\$ 443 billion in 2012 – out of total household expenditures of \$1.1 trillion – which exceeds the size of any other sector**²⁸. The relatively high prices of animal products means that four out of the top ten agricultural commodities by value are livestock ones²⁹.

Within the general food category, **consumption of animal-source foods is the fastest growing sub-category**: between 2005/07 and 2030, meat and milk consumption are projected to grow by 2.8 and 2.3 percent per year in Africa, while the demand for cereals, fruits and vegetables are anticipated to grow by about 2.1 percent

FIGURE 1. HOUSEHOLD CONSUMPTION EXPENDITURE IN AFRICA (US\$, BILLION), 2012.



Source: Elaborated from AfDB, 2012²⁸



“Demand for livestock in Africa is estimated to not only grow fast, but more quickly than other regions of the world.”

per year³⁰. As economic development progresses and per capita income increases, households start diversifying their diet: they consume not only staples such as rice, maize and millet, which are the cheapest source of calories, but also more expensive products of higher quality, such as those containing more protein or vitamins. These include livestock products³¹.

Demand for livestock products in Africa is anticipated not only to grow fast, but also more quickly than

in other regions of the world. Figures 2 and 3 present three basic measures of regional growth in meat and milk markets in 2005/07, 2030 and 2050, while Figure 4 provides details on the African market by livestock product³⁰. These are:

- Market size, as measured by the volume of current (2005/07) and projected consumption of livestock products in 2030 and 2050.
- Market growth, as measured by the additional volume of animal-source foods consumed from 2005/07 to 2030 and to 2050.
- Market growth, as measured by the annual growth rate in consumption of livestock products over the reference period.

Over the coming decades, African livestock markets hold the potential to generate major business opportunities for livestock producers, in many cases larger than those of other regions. Between 2005/07 and 2050 Africa’s increase in the volume of meat consumed will notably be on a par with that of the developed world and that of Latin America, with only South Asia and East Southeast Asia projected to record larger gains (Figure 2). For milk, only South Asia will register a larger growth in market size than Africa (Figure 3). Finally, annual growth rates in both meat and milk consumption are projected to be higher in Africa than in other regions, with the exception of meat in South Asia (Figures 2 and 3).

In Africa, milk is the most-consumed animal protein source in terms of volume, as it is cheap, widely available and easily traded and consumed in small quantities. Africans are estimated to have consumed about 32.4 million tonnes of milk in 2005/07, and this number is expected to rise by some 50.2 million tonnes by 2050, pushing up the total volume of the milk market to almost 83 million tonnes. **Beef and poultry are Africa’s most consumed meats** — at about 4.7 and 2.9 million tonnes in 2005/07 respectively — followed by mutton and pork which, for cultural reasons, is less consumed in some countries. By 2050,

consumption of beef and poultry is estimated to increase by an additional 8.9 million tonnes, with the total market size for beef reaching 13.6 million tonnes and that of poultry 11.8 million tonnes. In 2050, the egg, pork and mutton (including both sheep and goat meat) markets will be about 6.1, 3.5 and 6.0 million tonnes, respectively (Figure 4).

In spite of these major market opportunities, **local producers are unable to meet current demands and will find it increasingly challenging to satisfy the growing needs for animal protein.** Figure 5 shows that Africa is anticipated to increasingly become a net importer of livestock products: meat imports are estimated to increase from 0.9 to almost 5 million tonnes between 2005/07 and 2050, and those of milk from 5.7 to 10.2 million tonnes. Unless investments in the sector are made now, it is projected that in 2030 and 2050 between 12 and 15 percent of African consumption will be supplied by foreign producers, as shown in the right side panel of Figure 5, in which each bar represents the proportion of the meat and milk consumed which is imported.

“Local producers are unable to meet current demands, resulting in a growth in net imports of animal products.”

FIGURE 2. ESTIMATED AND PROJECTED SIZE OF MEAT MARKETS IN MAJOR WORLD REGIONS 2005–07, 2030 AND 2050

	Estimated consumption 2005/07, million tonnes	Growth, million tonnes		Estimated consumption million tonnes 2050	Annual growth rate 2005/07–2050
		2005/07–2030	2030–50		
Developed	108.1	16.8	6.6	131.5	0.4%
Africa	10.5	10.3	13.9	34.8	2.8%
Near East	7.1	7.0	6.1	20.2	2.4%
Latin America	33.9	17.0	9.7	60.6	1.3%
South Asia	6.7	12.8	21.0	40.4	4.1%
East Southeast Asia	86.6	50.8	22.8	160.3	1.4%

Source: Elaborated from data of the FAO Global Perspective Studies Unit³⁰

FIGURE 3. ESTIMATED AND PROJECTED SIZE OF MILK MARKETS IN MAJOR WORLD'S REGIONS 2005-07, 2030 AND 2050

	Estimated consumption 2005/07, million tonnes	Growth, million tonnes		Estimated consumption million tonnes 2050	Annual growth rate 2005/07-2050
		2005/07-2030	2030-50		
Developed	273.2	35.2	11.2	319.6	0.4%
Africa	32.4	24.8	25.4	82.6	2.2%
Near East	23.8	14.2	11.1	49.1	1.7%
Latin America	61.7	25.5	13.3	100.5	1.1%
South Asia	107.7	81.5	71.8	261.0	2.0%
East Southeast Asia	45.6	32.2	10.7	88.4	1.5%

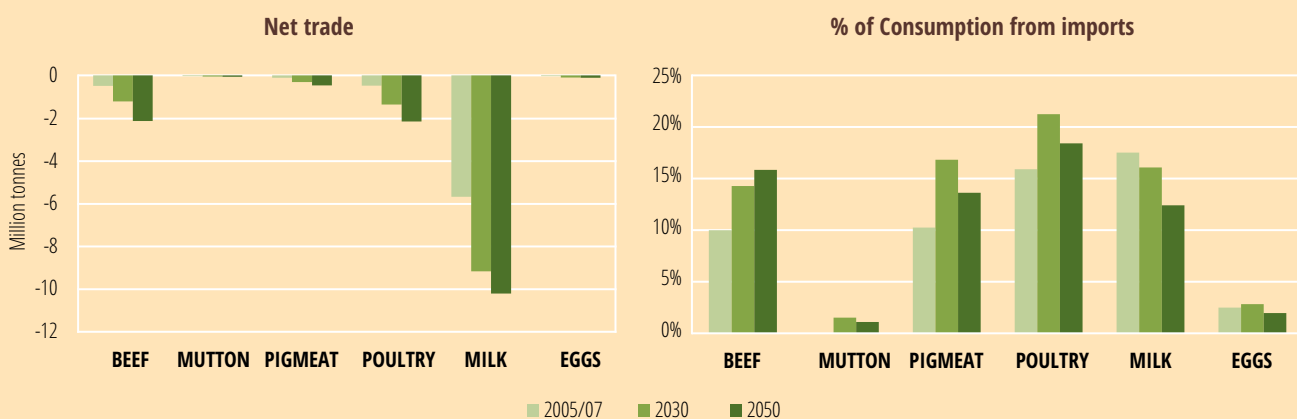
Source: Elaborated from data of the FAO Global Perspective Studies Unit³⁰

FIGURE 4. ESTIMATED MARKET SIZE OF LIVESTOCK PRODUCTS IN AFRICA 2005-07, 2030 AND 2050

	Estimated consumption 2005/07, million tonnes	Growth, million tonnes		Estimated consumption million tonnes 2050	Annual growth rate 2005/07-2050
		2005/07-2030	2030-50		
Milk	32.4	24.8	25.4	82.6	2.2%
Eggs	1.6	2.0	2.5	6.1	3.1%
Pigmeat	.08	1.1	1.5	3.5	3.3%
Mutton	2.2	1.7	2.1	6.0	2.3%
Poultry	2.9	3.6	5.3	11.8	3.3%
Beef	4.7	3.9	5.0	13.6	2.5%

Source: Elaborated from data of the FAO Global Perspective Studies Unit³⁰

FIGURE 5. AFRICA'S MEAT AND MILK TRADE POSITION: 2005/07, 2030 AND 2050



Source: Elaborated from data of the FAO Global Perspective Studies Unit³⁰

3. THE DEMAND FOR ANIMAL-SOURCE FOODS

Who is Buying What, Where?

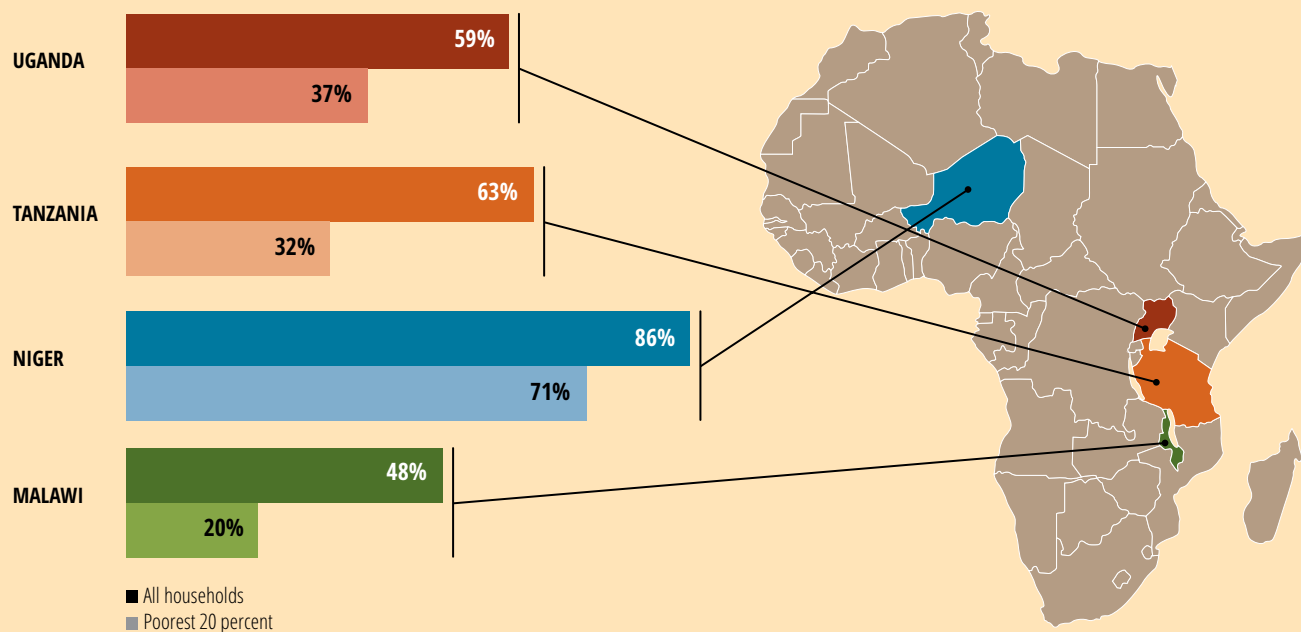
Despite the growth in demand in sub-Saharan Africa for livestock products, **per capita consumption of livestock products remains low**, averaging in 2005–2007 about **14 kilos of meat and 30 liters of milk per year** vis-à-vis 87 kilos and 214 liters in the developed economies³⁰. Household level data show that **over one-third percent of African households currently do not consume animal-source foods** on a regular basis, i.e. at least once a week^{18, 21–23}.

Figure 6 presents the shares of households in Malawi, Niger, Uganda and Tanzania reported to consume animal-source foods in the week before they were interviewed.⁴ Data are presented both for all households and for the poorest 20 percent of households. It is noteworthy that, with the exception of Niger, fewer than two-thirds of households appear to consume livestock products: the range going from 48 percent of households in Malawi to 86 percent in Niger. These proportions are lower among the poor: the range of poorest households consuming animal-source foods goes from 20 percent in Malawi (with 80 percent of them not consuming livestock products) to 71 percent in Niger.

a The Ghana, Madagascar and Niger datasets, also used in this paper, are not suitable for generating statistics on weekly food consumption.

“Understanding market-driven demand for livestock products is critical to investing in the sector.”

FIGURE 6. SHARE OF HOUSEHOLDS CONSUMING LIVESTOCK PRODUCTS IN SELECTED AFRICAN COUNTRIES



Source: Calculated from National Multi-topic Household Survey data^{18, 21-23}

It should be noted that not all households that consume animal-source foods purchase them. Households that keep livestock, and in particular poultry and milking animals, often consume only their own products. **In general, between 25 and 50 percent of all households purchase animal-source foods on a regular basis**, i.e. at least once a week. In Ghana and Malawi, for instance, about one-third of all households reported purchasing some livestock products; this share goes up to about half in Tanzania and Uganda^{17, 18, 22, 23}.

Consumers purchase livestock products in a variety of outlets and in different retail forms. For example, they can purchase meat in open air (so-called wet) markets, roadside outlets, small retail shops, supermarkets and other formal or informal premises. Milk is also available from bicycle vendors and milk kiosks. Beef products include parts and steak, offals, ground meat and sausages, and by-products such as hides and skins and tallow. Milk can be purchased as raw, pasteurized or processed in a variety of forms, such as yogurt and cheese. Poultry is usually available as live birds, dressed chicken or mixed pieces³²⁻³⁶. As an example, Figures 7 and 8 display common retail outlets for meat products and common retail forms for beef in East Africa.

FIGURE 7. RETAIL OUTLETS FOR MEAT PRODUCTS IN EAST AFRICA

Abattoir



Butchery



Open air market



Roadside outlet



Small retail shop



Supermarket



FIGURE 8. BEEF: MAJOR RETAIL FORMS IN EAST AFRICA

Carcass (part of)



Steak/fillet



Mixed pieces



Ground beef



Sausages



Offals



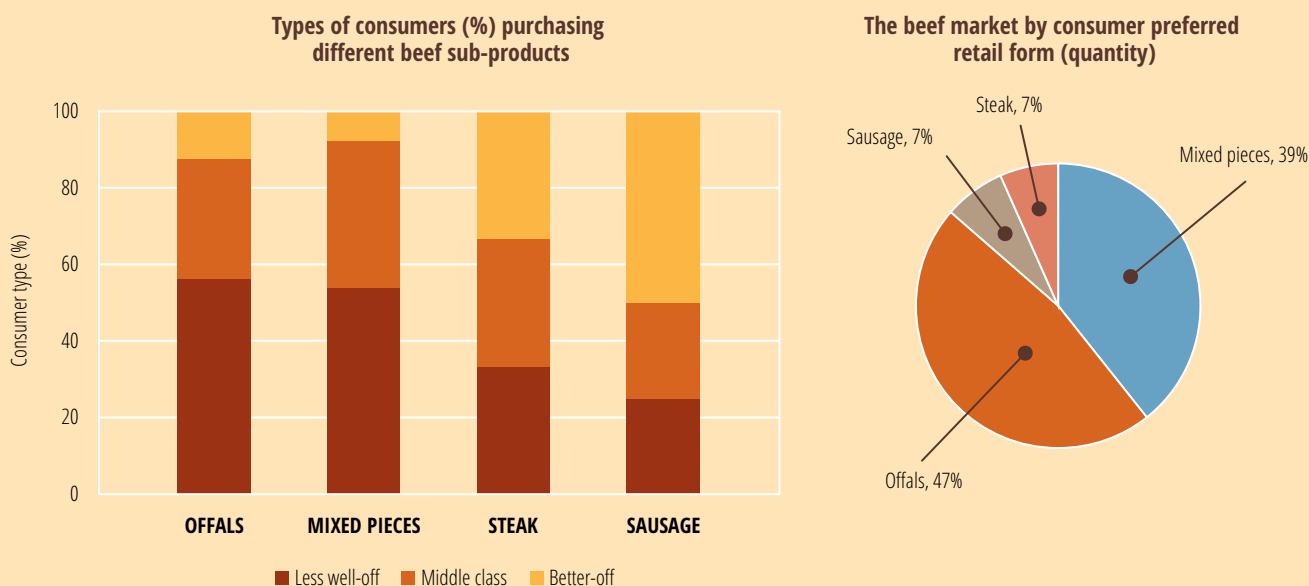
“Market demand for livestock products in the future will be influenced by the preferences of less well-off households.”

These retail product forms command different prices in the market: i.e. steak is higher priced than is offals. This is reflected in the purchasing behavior of different income groups of consumers in terms of choice of retail form, the volumes purchased and the frequency of purchase. Therefore, in combination with urbanization and demographic changes, **income levels influence consumers’ preferred retail forms.**

There are no comprehensive datasets through which the market demand for the different retail forms of livestock products can be derived, but recent consumer and retailer surveys undertaken by ILRI and FAO in Tanzania and Uganda provides interesting hints^{33,34}. Figures 9, 10 and 11 present, for Tanzania, the retail forms preferred by consumers in different wealth brackets (so-called less well-off; middle class; better-off) for beef, poultry and milk — the most consumed livestock products in Africa — and national demand for the same products by retail form. The latter has been estimated by integrating results from a consumer survey with nationally representative household data on diet composition, as collected by the Tanzania government in the 2008/09 National Panel Survey²².

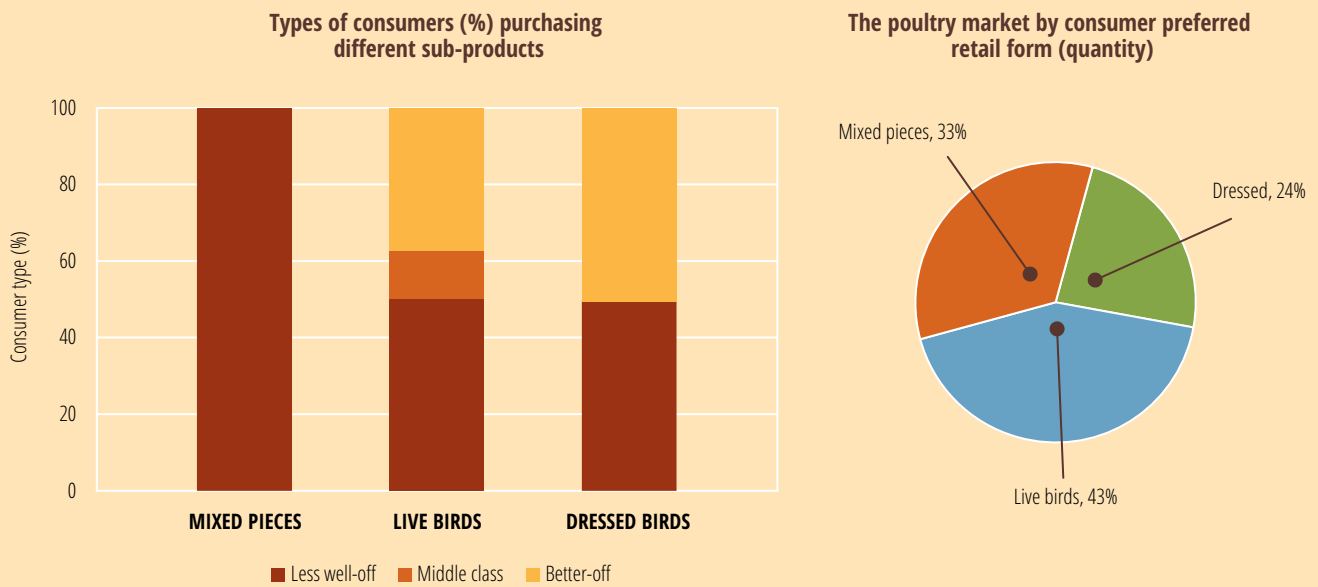
Given that consumers’ preferences for retail forms are related to their income levels and the largest share of them has limited income, **the current market for animal-source foods is dominated by the retail forms preferred by the less**

FIGURE 9. TANZANIA: THE BEEF MARKET BY CONSUMER TYPE AND PREFERRED RETAIL FORM



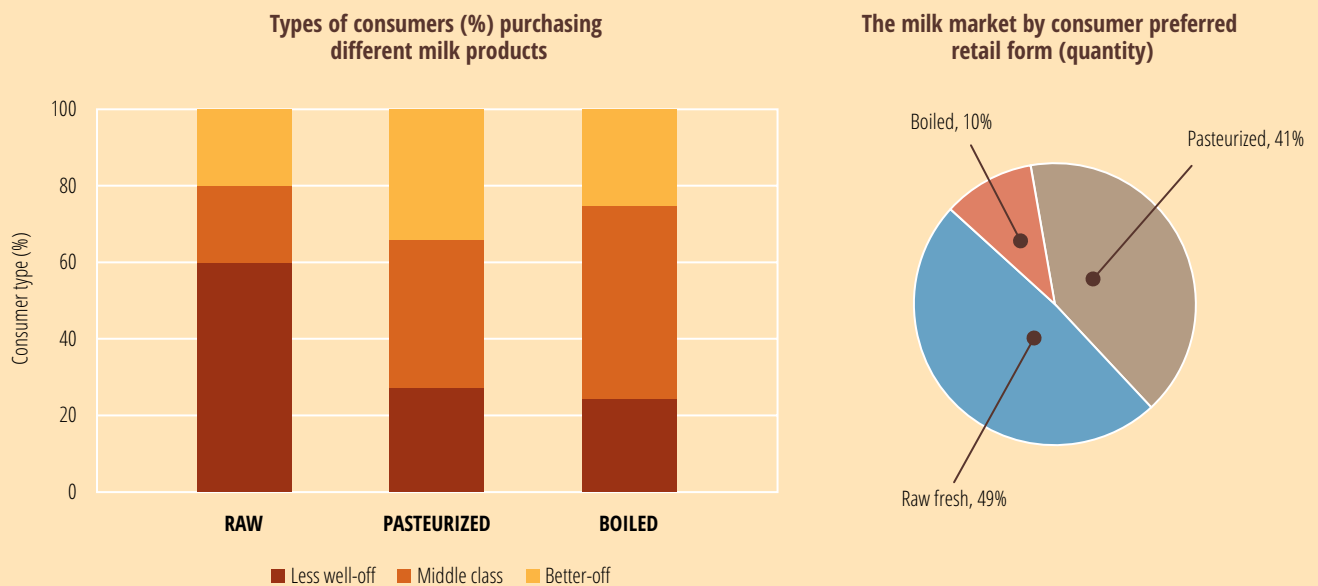
Source: Pica-Ciamarra *et al.*³⁴

FIGURE 10. TANZANIA: THE POULTRY MARKET BY CONSUMER TYPE AND PREFERRED RETAIL FORM



Source: Pica-Ciamarra *et al.*³⁴

FIGURE 11. TANZANIA: THE MILK MARKET BY CONSUMER TYPE AND PREFERRED RETAIL FORM



Source: Pica-Ciamarra *et al.*³⁴



well-off. These products include **offals and mixed pieces for beef; live birds and mixed pieces for poultry meat; and raw milk.**

Consumers of all wealth categories purchase animal-source foods in some type of retail outlets, but the surveys cited above suggest that retail outlets of preference for the less well-off are most likely to be roadside outlets and small retail shops. Middle class and better-off consumers are more likely to purchase animal foods in supermarkets, butcheries and milk kiosks. A noteworthy finding of the ILRI-FAO consumer surveys is that **low income consumers don't necessarily choose low quality products**, which are often cheaper^{33,34}. A plausible reason is that consumers in low income brackets purchase livestock products less frequently than do middle class and better-off households and, for them, any purchase of animal-source food is considered as a major and occasional expense,

contemplated after some consideration and with caution. This logic suggests that, before buying any animal-source product, poor consumers want to ensure good overall quality of the product.

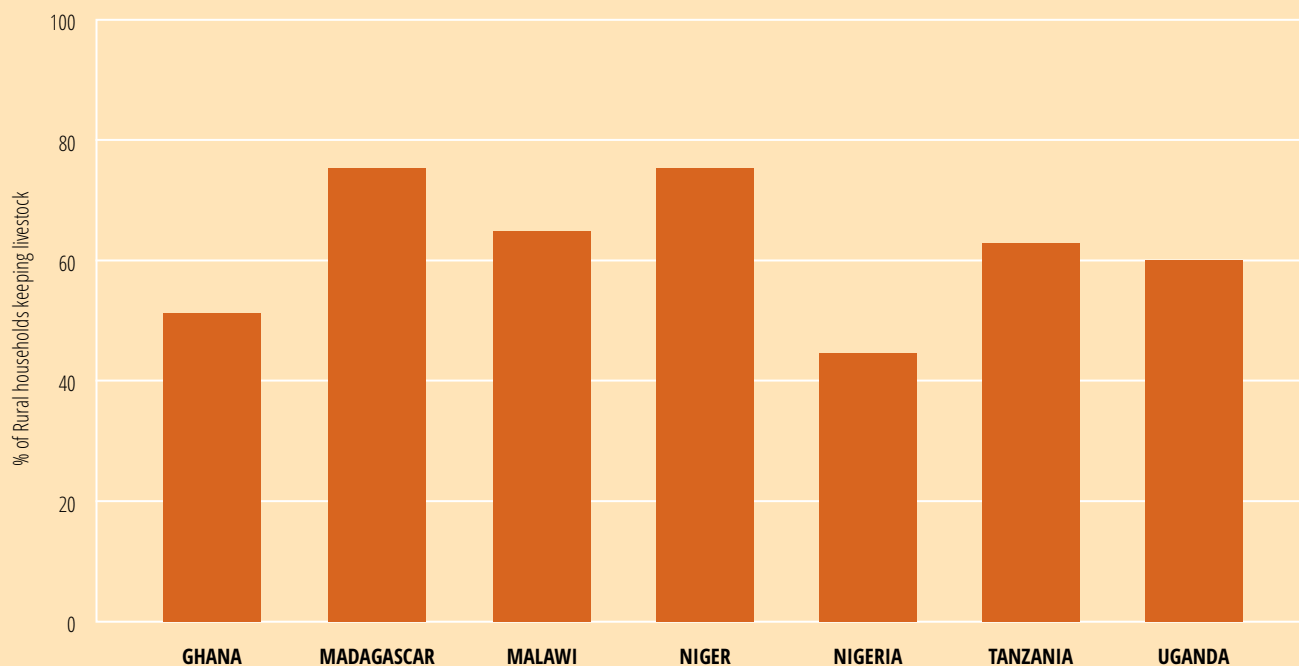
4. GETTING TO KNOW AFRICAN LIVESTOCK PRODUCERS

“Livestock are considered valuable assets by most rural households of all income levels.”

Domestically produced animal-source foods are derived from a variety of livestock operators who can be differentiated into two major categories, namely **commercial livestock enterprises** and **agricultural households**.

Commercial livestock enterprises are registered companies with a certain number of permanent wage employees and keeping herds/flocks of hundreds of animals/thousands of birds. **In a typical African country, there is a limited number of commercial livestock enterprises.** In Tanzania, for example, the agricultural census reveals that there are 330 commercial enterprises specialized in livestock³⁷; in Botswana, one of the countries, along with Namibia, which has a commercial livestock sector focused on export markets, there are a total of 527 commercial beef farms³⁸; Malawi's larger livestock farms (254 with over 500 cattle) are mostly commercial companies³⁹. Being so few, commercial enterprises often do not contribute much to overall livestock production: in Tanzania, for instance, they are estimated to contribute 5.1 and 5.3 percent of all beef and milk production, respectively⁴⁰.

FIGURE 12. SHARE OF RURAL HOUSEHOLDS KEEPING LIVESTOCK

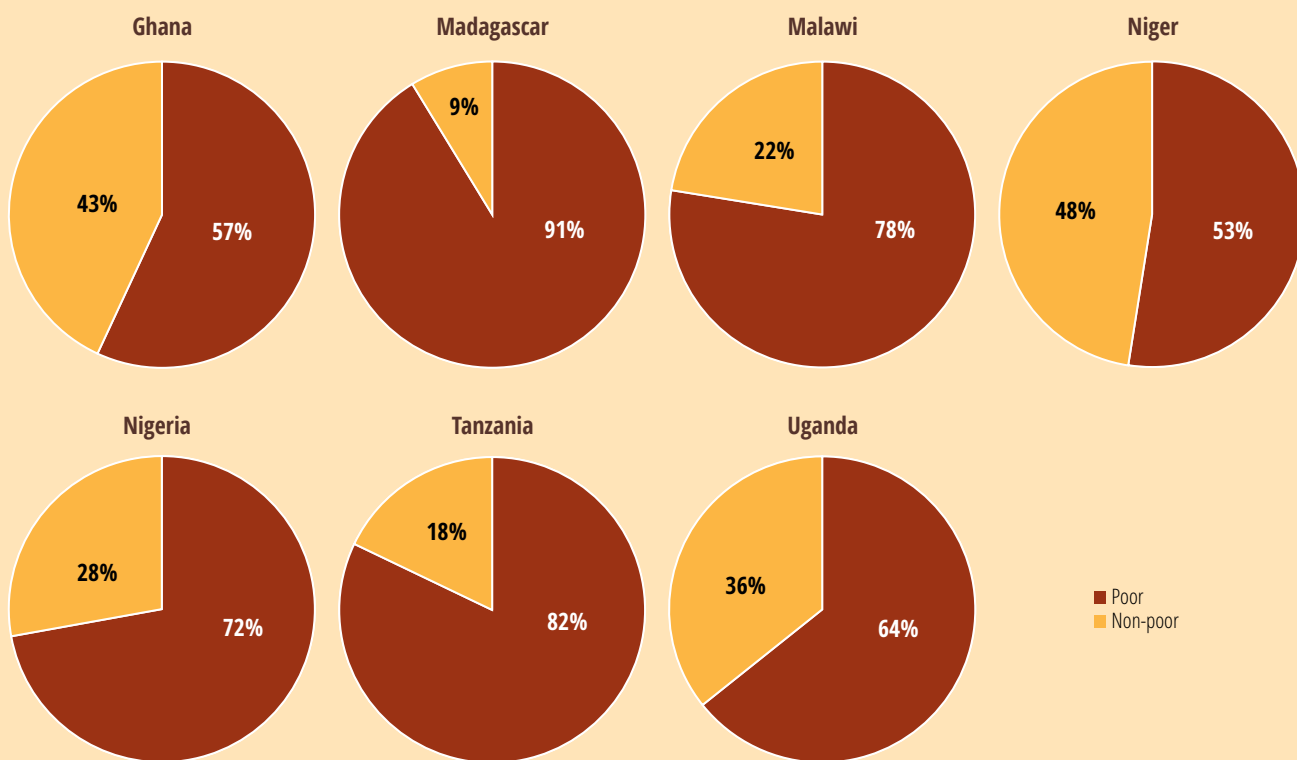


Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

In contrast, **livestock are a commonly held asset among rural households of all income levels**, for both the poor and the non-poor. Most rural households are agricultural households, as they depend on self-employment in farming for their livelihood, with dependency on agriculture usually defined in terms of time devoted to and/or income from farming. Many, and often the majority of agricultural households, are livestock keepers. Data from seven sub-Saharan African countries, including Ghana, Madagascar, Malawi, Niger, Nigeria, Tanzania and Uganda, show that **almost two-thirds of rural households keep livestock**, from a low 44 percent in Nigeria up to 79 percent in Niger¹⁷⁻²³. These proportions translate in a significant number of households — e.g. over 3 million in Uganda and 1.5 million in Malawi — who are managing the largest share of the national herd/flock^{18,23}. In Tanzania, households are estimated to keep over 95 percent of the country's cattle and poultry⁴⁰.

A key development question is whether livestock ownership has implications for household wealth. **Surveys show no clear relationship between households' livestock ownership and wealth**, and that **poverty is as prevalent among livestock-keeping households as among those with no livestock**. Given current poverty rates in rural areas², therefore, over two-thirds of rural livestock keepers

FIGURE 13. RURAL LIVESTOCK KEEPERS: POOR (< US\$ 1.25 DAY) AND NON-POOR



Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

are found to be extremely poor (< US\$ 1.25 day) in the sample countries, from a minimum of 53 percent in Niger to over 90 percent in Madagascar.

Poultry are kept by about half of rural households; one-fourth of them keep sheep or goats; one-fifth keep cattle, including dairy cows. Among surveyed rural households, very few, about 5 percent, keep pigs. **About half of all livestock-keeping households keep only one species of animal** while **one-fourth of them are more diversified and manage two livestock species**¹⁶⁻²².

Again, **there is no clear correlation between ownership of animals by species and level of wealth**. For example, cattle, which are by far the most valuable animals, are more likely to be kept by the poor in Madagascar but, in Tanzania, the majority of cattle herds are owned by wealthier households^{19,22}. In Ghana, the poor are more likely to keep poultry, the least valuable animals, but the reverse is true for Uganda^{17,23}.

Statistical analyses targeting only rural livestock-keeping households show that the majority of them keep relatively small herds/flocks. Figure 14 displays the

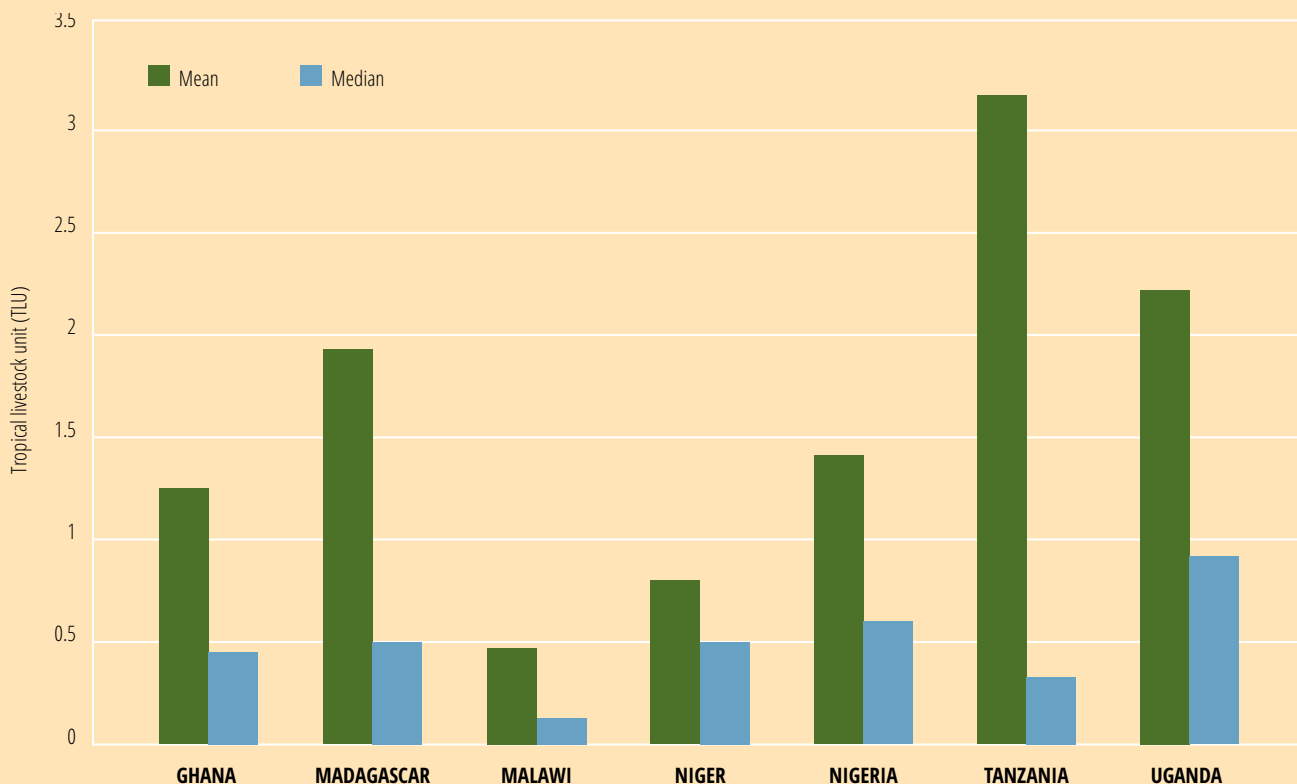
mean and median herd/flock size, expressed in Tropical Livestock Units (TLUs), of rural livestock-keeping households in the sample countries. TLU, equivalent to 250 kg live weight, standardizes live animals by species mean live weight.

The average livestock-keeping household keeps about 1.60 TLUs, which is equivalent to about three cattle. The median livestock-keeping household keeps about 0.5 TLU, which is equivalent to one beef animal. In other words, **about half of livestock-keeping households manage herds/flocks of one beef animal or less.**

Given that a rural household is usually composed of about five members or more, on a per capita basis this translates in **an average of 0.6 TLU** and **a median of 0.1 TLU per household member.**

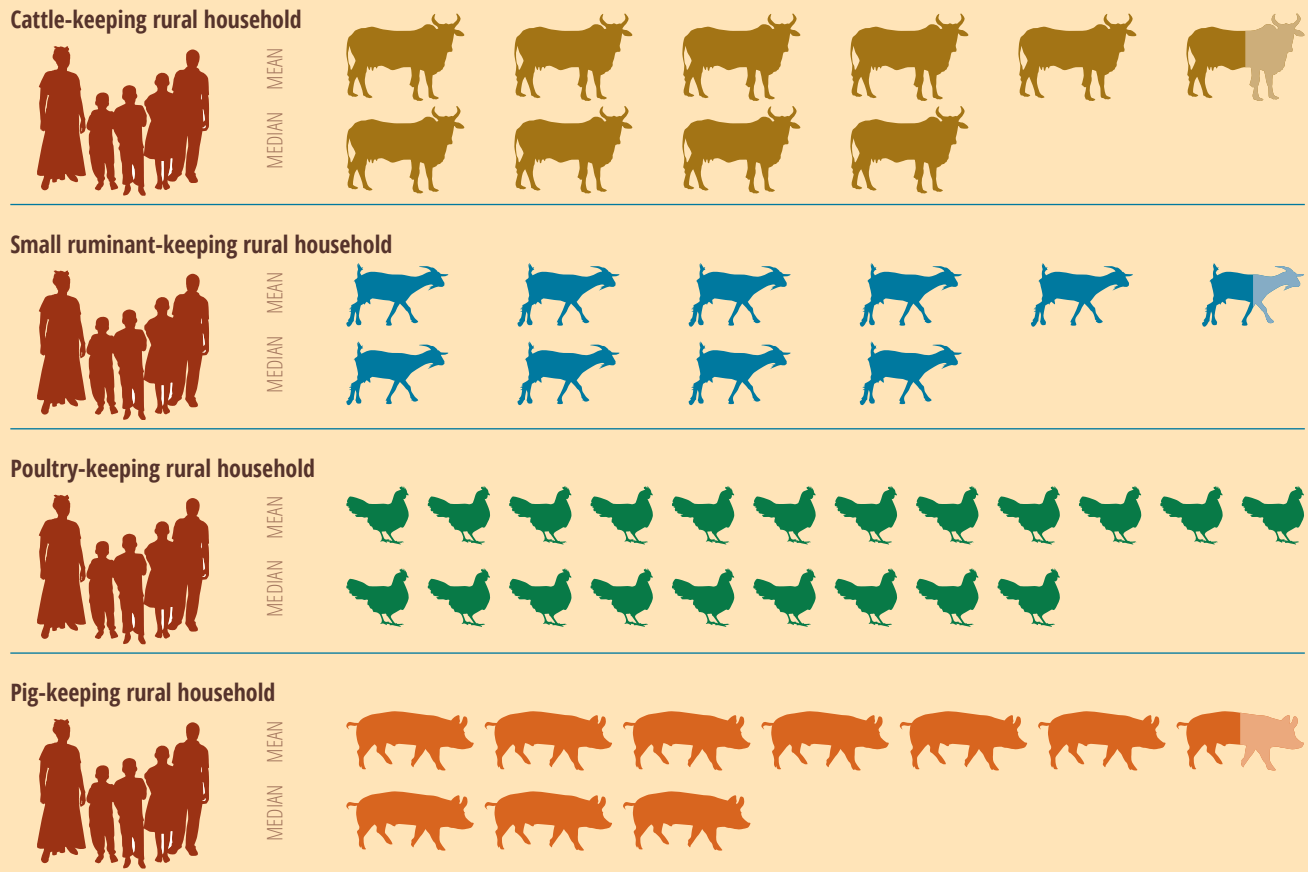
As rural households — as shown above — tend to keep only one species of animals, Figure 15 presents the average and median herd size for sub-samples of households who keep only cattle, only sheep and/or goats, only pigs or only poultry. This provides a picture different than that emerging from Figure 14.

FIGURE 14. MEAN AND MEDIAN HERD/FLOCK SIZE OF RURAL LIVESTOCK-KEEPING HOUSEHOLDS



Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

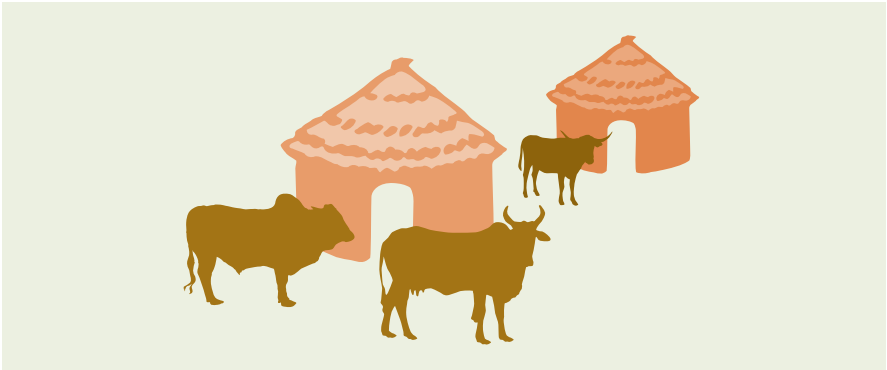
FIGURE 15. AVERAGE/MEDIAN HERD SIZE FOR 'SPECIALIZED' LIVESTOCK-KEEPING HOUSEHOLDS IN SUB-SAHARAN AFRICA



Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

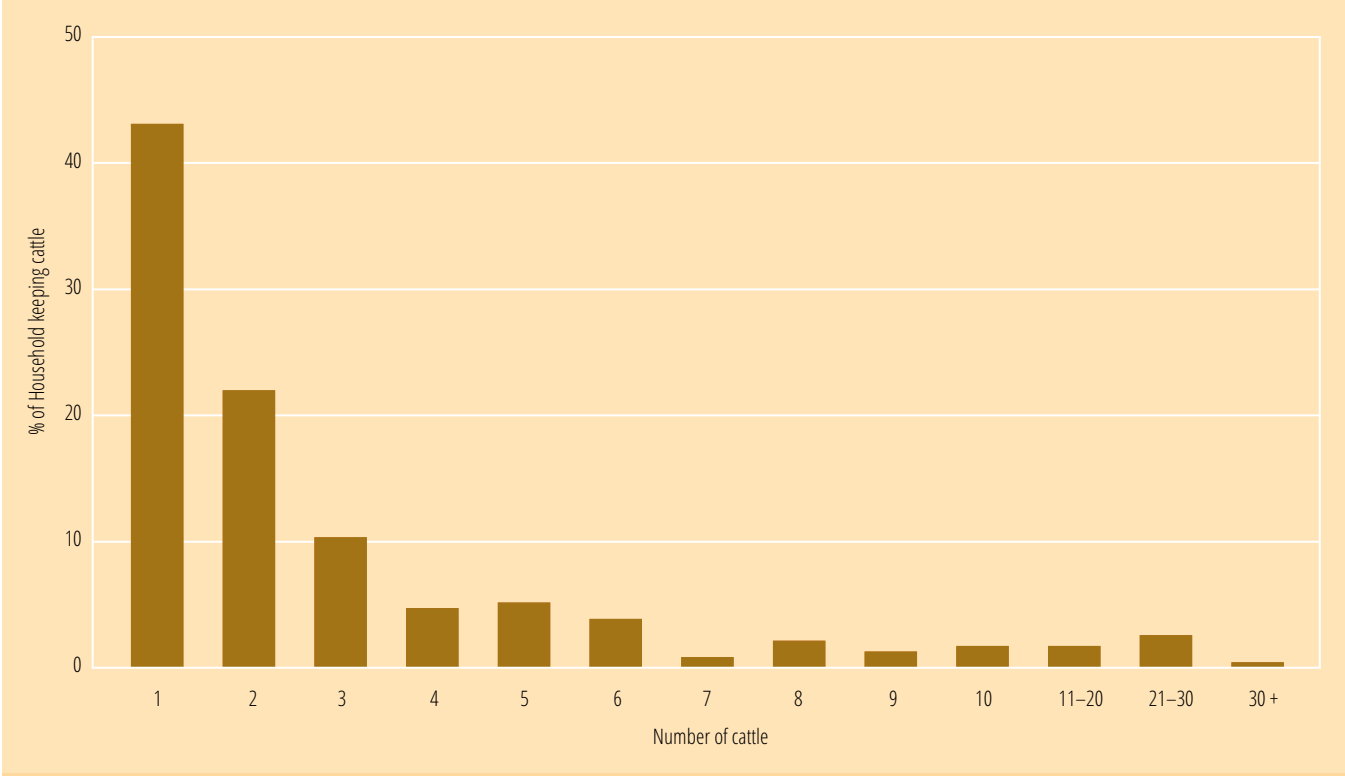
The graphs reveal that across the sample countries a typical cattle- and small ruminant-keeping household keeps on average 5.5 animals, but half of those keeping cattle or sheep/goats own four or fewer animals; a poultry-keeping household, rather, maintains a flock of about 12 birds on average, but half of them have nine or fewer birds; and a pig-keeping household keeps about 6.5 animals on average and a median of three.

A conclusion emerging from the above analysis is that the distribution of animals across households is not uniform. Figures 16, 17 and 18 display histograms on the distribution of animal ownership in Tanzania for cattle-, small ruminant- and poultry-keeping households. These graphs reveal that **there is disparity in livestock ownership, with the largest share of households keeping one or few animals, and a minority keeping relatively large herds/flocks.**



“Almost two-thirds of rural households keep livestock.”

FIGURE 16. TANZANIA: CATTLE DISTRIBUTION ACROSS CATTLE-KEEPING RURAL HOUSEHOLDS



Source: Calculated from NBS, 2009²²

“Most households are characterized by small herds/flocks.”

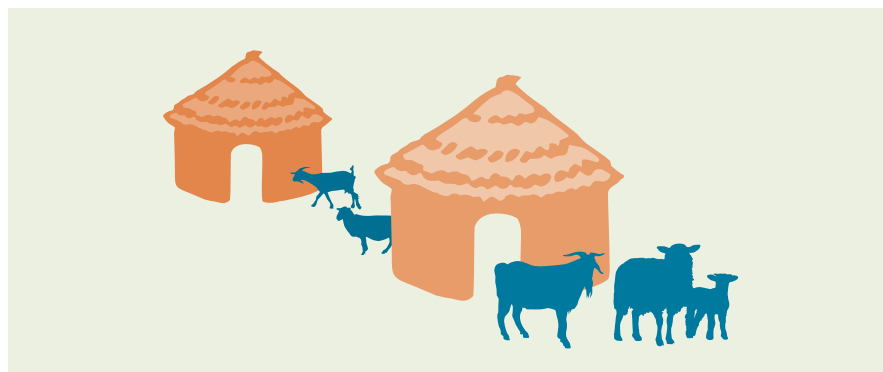
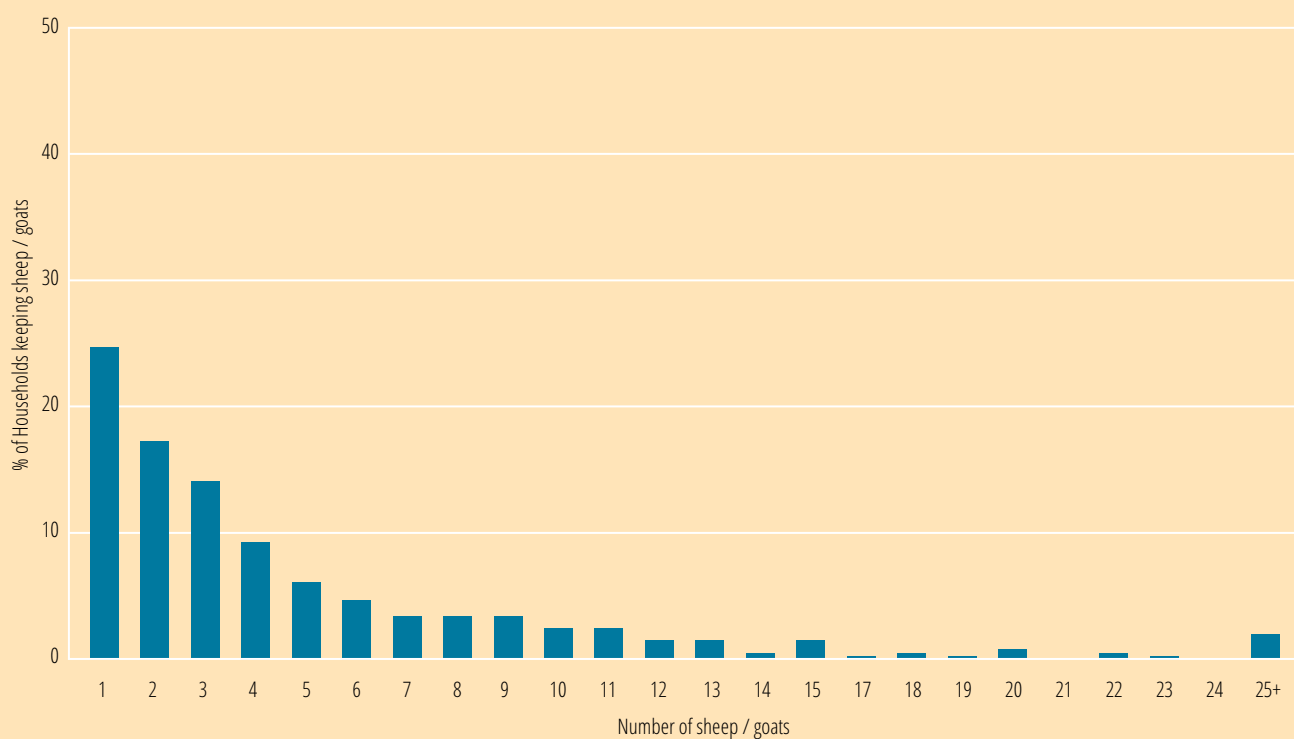
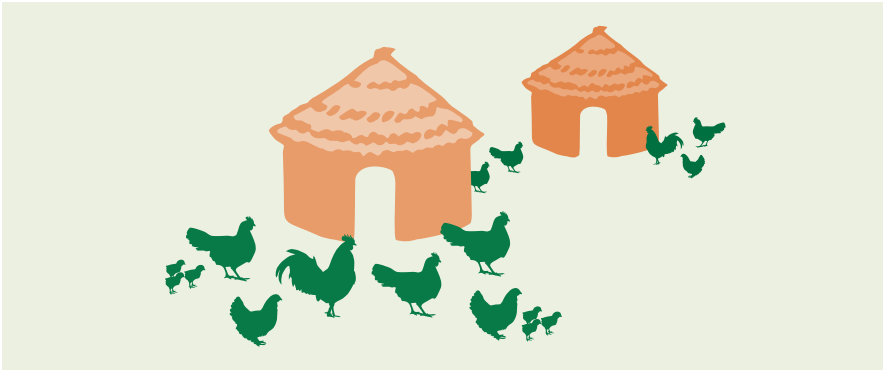


FIGURE 17. TANZANIA: SMALL RUMINANT DISTRIBUTION ACROSS GOAT/SHEEP-KEEPING RURAL HOUSEHOLDS

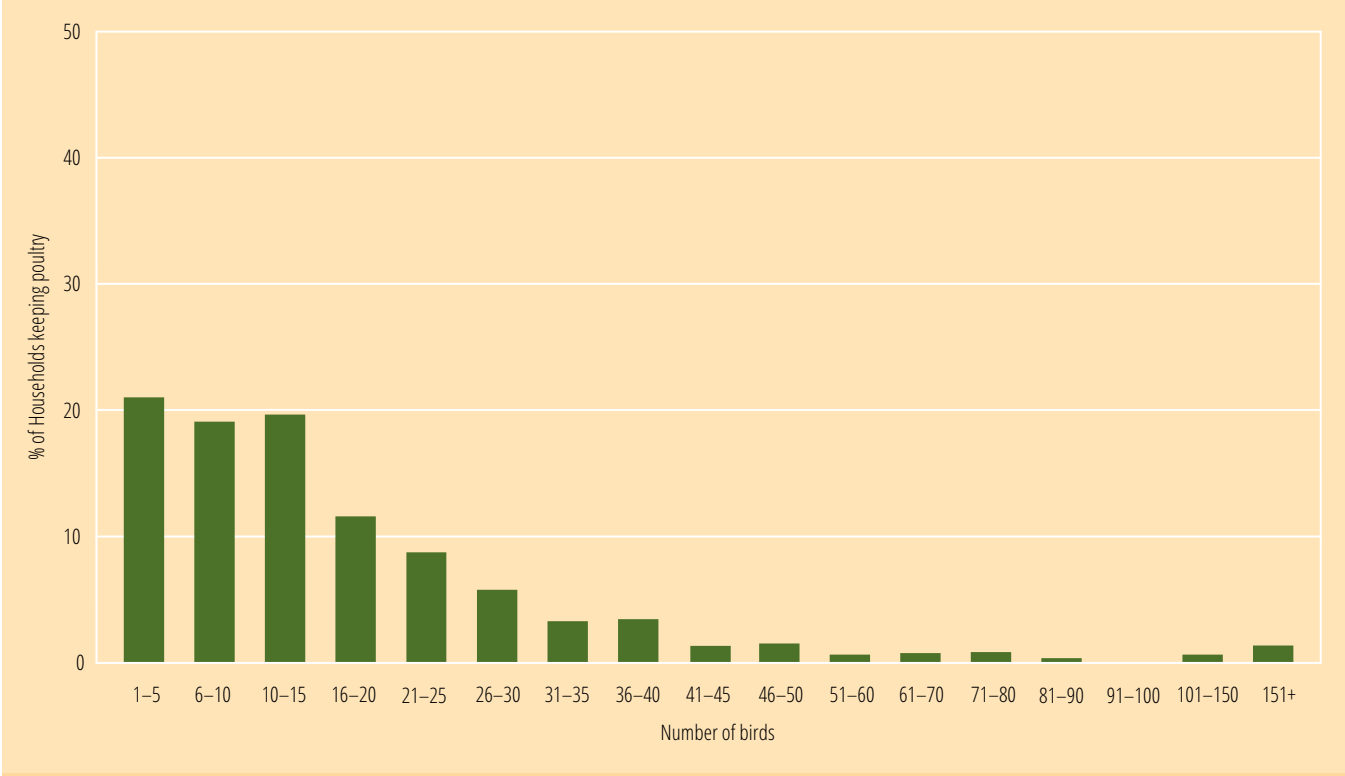


Source: Calculated from NBS, 2009²²



“The majority of rural households have one or less large animals.”

FIGURE 18. TANZANIA: POULTRY DISTRIBUTION ACROSS POULTRY-KEEPING RURAL HOUSEHOLDS



Source: Calculated from NBS, 2009²²

“Business-oriented livestock keepers are the minority of livestock households, ranging from 5-20 percent.”

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5. INCREASING RETURNS FROM LIVESTOCK

Livelihood-Oriented and Business-Oriented Livestock Keepers

Livestock keepers, the majority of whom are poor, could derive greater benefits from their livestock. However, **it is unclear whether all livestock households are willing or able to respond to economic incentives to serve the expanding market for animal protein.** Moreover, environmental and other constraints may limit the extent to which livestock-keeping households can respond to such incentives.

Households' willingness to invest in livestock ultimately depends on the benefits generated. These benefits can be of a financial nature, but also may serve many other social and livelihood household needs. First, **livestock provide cash and in-kind income through the sale of animals and/or the sale and/or self-consumption of milk, meat, eggs and other animal products.** Second, **livestock are a form of savings and insurance,** as the sale of animals provides immediate cash to deal with significant or unexpected expenditures (for example, school or medical fees). Third, **livestock provide manure, draft power and transport services,** which can be used by the household or exchanged on the market (for example, rental of bull for ploughing). Fourth, being a source of wealth, **livestock contribute to social status and facilitate access to financial services.** Finally, because some livestock can be kept close to the village and require few labor inputs, such as a small flock of poultry birds, these can be tended by women while they are also managing other time-consuming activities (for example, cooking or child care), thereby falling under their control and providing some degree of **empowerment**⁴¹⁻⁴⁵.

Several of the benefits generated by investments in livestock are not associated with fully tradable products or with products which are regularly exchanged in the market: dung and hauling services are an example. These types of benefits are thus difficult to measure. However, **the incentives to increase livestock production/productivity to tap into the growing market for animal-source foods largely depend on the cash income that selling livestock products and live animals can generate.** This can be measured with some accuracy, as most surveys contain information on the sale of animals and tradable livestock products and, in many circumstances, also on the cost of production.

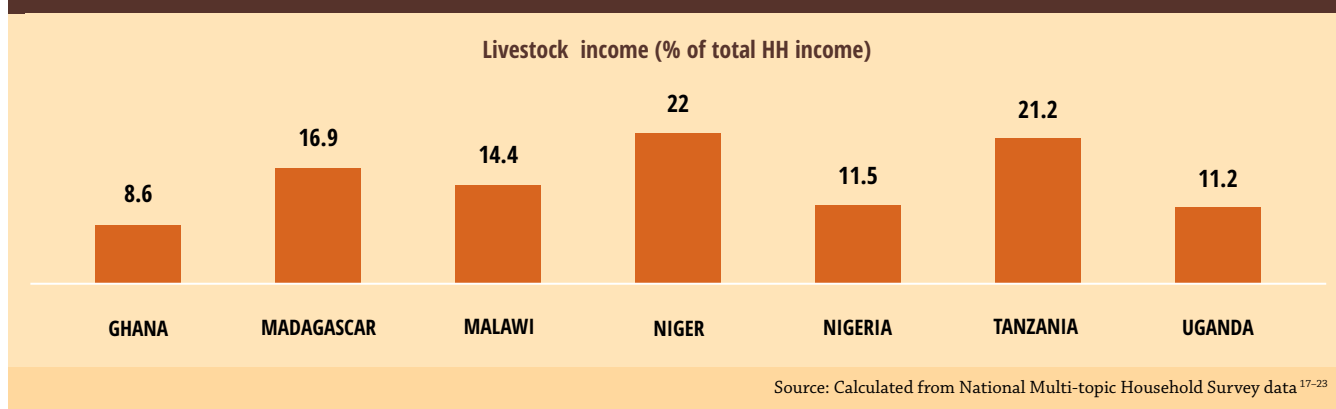
Available data show that **over 90 percent of livestock keepers derive some cash income from selling meat, milk and eggs, as well as live animals, in the market.** They also reveal, however, that **the typical livestock-keeping household derives between 9 and 22 percent of its total income from livestock** (Figure 19), with income calculated as the total value of production net of the value of some inputs for which data are available, such as purchased feed, labor and veterinary services/drugs. Only in two countries of the seven surveyed, namely Niger and Tanzania, do livestock contribute more than 20 percent to the income of the livestock-keeping household. These results are not surprising, given the small number of animals kept by the average livestock-keeping household (see Figure 14).

Furthermore, given that — as shown above — there is disparity in livestock ownership and most households keep small herds/flocks, **over half of all livestock-keeping households derive less than 10 percent of their income from livestock.** Statistical analyses show that in just four of the seven countries presented here does livestock ownership contribute to expenditure level — which is correlated to income — when also accounting for other variables that are expected to influence household expenditure, such as land ownership, education and wage employment.

Households that derive relatively little monetary benefits from their animals have little incentives to increase livestock production/productivity with the specific objective of selling



FIGURE 19. MEAN INCOME FROM LIVESTOCK AS SHARE OF TOTAL HOUSEHOLD INCOME – LIVESTOCK-KEEPING HOUSEHOLDS



“Households that own livestock are more likely to consume animal-source foods.”

©FAO/Giulio Napolitano

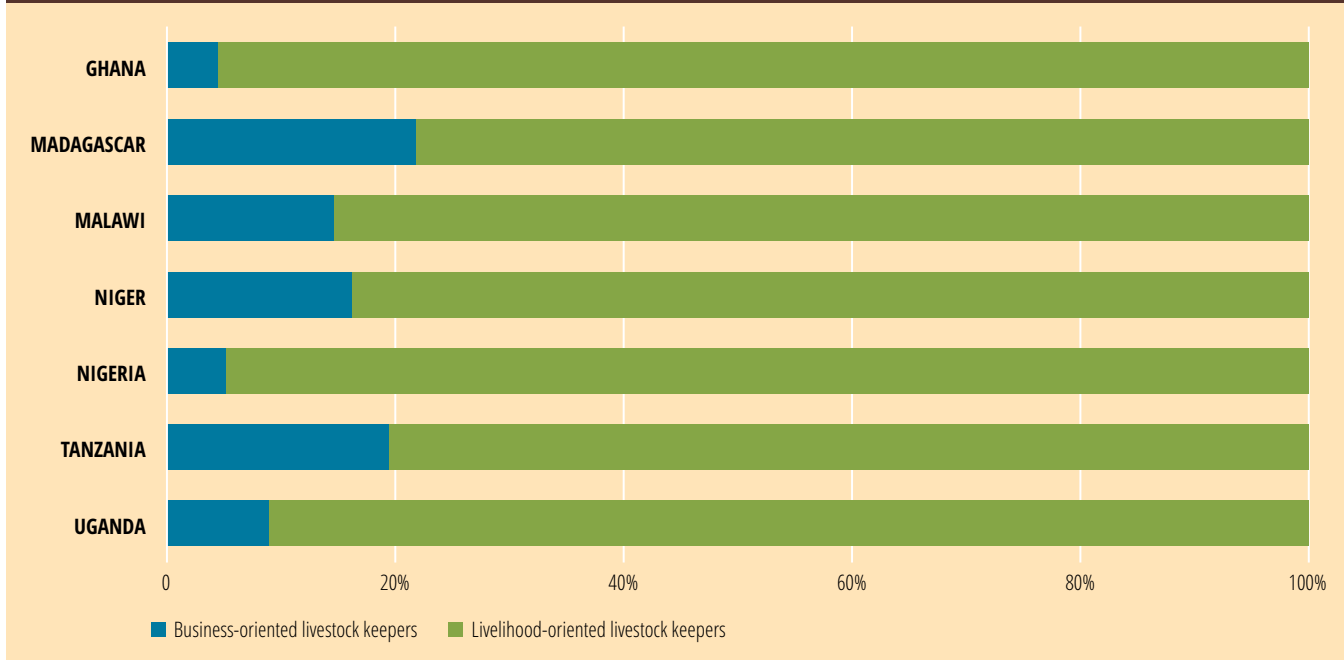


surplus production in the market. Indeed, even if the relative returns on these investments were high, their absolute value would be low from a livelihoods perspective. For example, a local breed hen can generate about 40 to 50 eggs per year⁴⁶. An investment that increases egg productivity by 30 percent would eventually give the household an additional 12 to 15 eggs per year, which for a family of five is of limited benefit. Households positioned in this way are here referred to as **livelihood-oriented livestock keepers**, as their livestock contribute marginally to their cash income, but do support livelihoods by providing a variety of basic goods and services, such as food, transport services and insurance. Many livelihood-oriented livestock keepers may be also defined as ‘forced or reluctant’ livestock keepers, as they are ready to step out of livestock as soon as alternative opportunities emerge, such as wage employment⁴⁷. Conversely, households that derive non-trivial income from engaging in livestock marketing will have incentives to invest in their animals. These households are here referred to as **business-oriented livestock keepers**, as they derive often a significant share of their cash income from regularly utilizing livestock markets, and often make investments with the objective of expanding market engagement.

While there is heterogeneity of livestock keepers and a continuum in the contribution of livestock to their income, such simple classifications are useful in guiding policy and investment decisions. Figure 20 presents the shares of livelihood-oriented and business-oriented livestock-keepers in selected countries. We define these, respectively, as those households deriving at least 25 percent of their total income from selling meat, milk, eggs and other livestock products in the market. The underlying arbitrary assumption is that above the 25 percent threshold, households are willing to invest to expand their livestock productivity and derive benefits from increased sales of meat, milk, eggs and other livestock products, including live animals.^b

^b Different income thresholds have been used to differentiate between livelihood-oriented and business-oriented livestock keepers with results consistently showing that business-oriented livestock keepers are a minority group. The 25 percent income threshold is a conservative one, as often the 50 or 75 percent income thresholds are used to define specialized agricultural producers^{24, 48–50}.

FIGURE 20. LIVELIHOOD-ORIENTED AND BUSINESS-ORIENTED LIVESTOCK KEEPERS

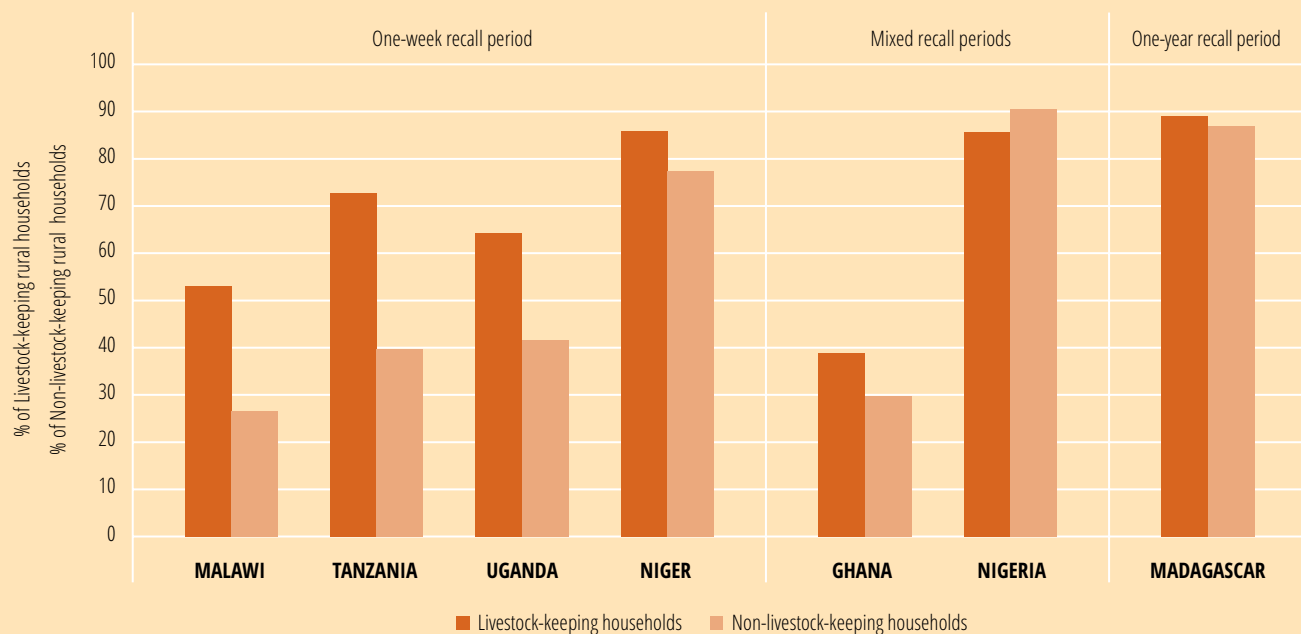


Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

Depending on the country, **between 5 and 21 percent of livestock-keeping households**, or between 2 and 17 percent of all rural households, **are anticipated to have incentives to increase livestock production and productivity to benefit from the growing demand for animal-source foods**. These statistics indicate that no more than 20 percent of all rural households are business-oriented livestock keepers. **The remainder, the great majority of households, are these so-called livelihood-oriented livestock keepers.**

Figure 21 provides some basic evidence on some of the non-cash contributions of livestock to household livelihoods, which explains why there are so many livelihood-oriented livestock keepers. It compares the proportion of rural households that keep livestock and consume animal-source foods with the proportion of rural households not doing so. The objective is to show empirically a potential positive impact of livestock ownership on food security and nutrition, and hence⁴⁵. The figure differentiates countries depending on whether households are asked questions on consumption of livestock products based on a one-week recall period (“did any member of this household consume meat/milk/eggs in the last week?”), a mixed recall period, which is the case when households are interviewed several times over a one-year period, and a one-year recall period.

FIGURE 21. SHARES OF RURAL LIVESTOCK-KEEPING AND NON-LIVESTOCK-KEEPING HOUSEHOLDS CONSUMING ANIMAL-SOURCE FOODS



Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

Livestock-keeping households appear more likely to consume livestock products than non-livestock-keeping households. Surveys reveal that in all countries, but for Nigeria, this holds true independent of the recall period used to inquire about the consumption of animal foods. The difference is large in all countries with the exception of Madagascar, where a one-year recall period is used. More importantly, statistical analyses show that in all countries, but for Madagascar, livestock ownership is a major determinant of the consumption of animal-source foods, even when considering other factors that can influence diet composition, such as income level, education, land ownership and other. In addition to the evidence on consumption, the cash-convertibility of livestock also means that households with livestock may be able to buy food of enhanced quality and nutritional value, whether or not of animal origin, and enhance food security.

6. INFORMATION PRIORITIES FOR AN EMERGING SECTOR

Investments aimed at improving the contribution of livestock to economic growth and poverty reduction should be differentiated depending on whether they target **livestock for livelihoods** or **livestock for business**. The former aims at enhancing the contribution of the benefits livestock generate for **livelihood-oriented livestock keepers**. These investments, depending on the circumstances, could become a first step on a ladder leading out of poverty by way of raised incomes, improved nutrition, better risk management, improved crop production or empowerment of women. In some circumstances, they may also assist livelihood-oriented livestock keepers to transition to business-oriented ones. The mechanisms for this need to be identified by further research, but may include provision of services or inputs, demonstration effects, alternative tenure arrangements for land and animals, and/or collective action in key value-adding stages of production and marketing. Such investment, with an entrepreneurial focus, aims to ensure that **business-oriented livestock keepers** generate additional surplus production and fully benefit from the growing demand for animal-source foods, thereby both improving their livelihoods and broadly contributing to economic growth and poverty reduction.

Investments targeting livestock for livelihoods and livestock for business are constrained by several information gaps both on the farm and beyond the farm. Filling these data gaps should be given priority by decision makers.

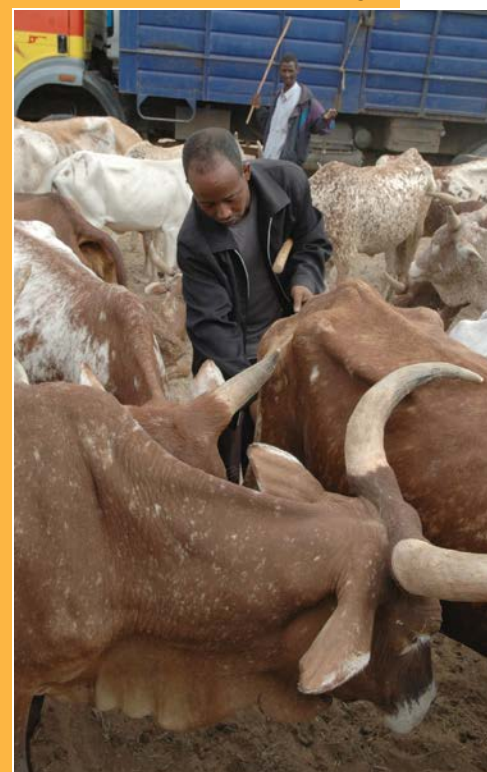
INFORMATION GAPS: LIVELIHOOD-ORIENTED LIVESTOCK KEEPERS

The design and implementation of policies and investments aimed at maximizing the benefits that livestock generate for livelihood-oriented livestock keepers should be based on an understanding of the role of livestock in the household economy. This requires generation of information and analysis on monetary and non-monetary benefits provided by livestock and the ways in which households use and relate to livestock. This is necessary, not to appreciate widely known husbandry practices and production constraints⁵¹⁻⁵⁵, but rather to quantify the return to livestock investments in terms of household livelihoods, and hence households' incentives to invest in their animals. This is a key piece of information to design policies and investments aimed at ensuring that livelihood-oriented livestock keepers derive the maximum benefits from their animals.

However, even the most mundane statistics, such as the number and proportion of households using dung as fertilizer or the quantity of livestock inputs purchased by farmers, are often not available at national level⁵⁶. This prevents appreciating the overall contribution of livestock to household livelihoods and

“There are two ways to invest in livestock: Livestock for business and Livestock for Livelihoods.”

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“Policies and investments need to better understand the role of livestock in the household.”

the incentives of livelihood-oriented livestock to invest in their animals. In general, what is known is largely based on *ad hoc* studies, and their conclusions lack the breadth or representativeness required for policy and investment guidance.

Governments should ensure that livestock is appropriately addressed in statistical surveys and, in particular, in multi-topic household surveys. Multi-topic household surveys — also called integrated household surveys or living standards measurement studies — consist of several questionnaires (e.g. household, community, agriculture) that collect information on many aspects of household structure, assets and resources, well-being and economic and social behavior. As such, they are appropriate to appreciate the contribution of livestock to livelihoods and measure the returns of livestock investments on households’ livelihoods. They then provide indications of households’ willingness to invest in livestock, and the factors affecting such willingness⁵⁷.⁵⁸ The FAO, ILRI, the World Bank and the African Union’s Interafrican Bureau for Animal Resources have recently jointly developed three livestock questionnaires to comprehensively incorporate livestock into multi-topic household surveys⁵⁶, and into other surveys, such as the census or a farm survey. The questionnaires solicit information from three major domains: livestock ownership; livestock inputs, i.e. husbandry practices; and livestock outputs (Table 1). They vary by size, but have four common, overarching goals:

- Generate basic statistics on key livestock-related variables, such as livestock ownership and access to animal health services;
- Understand household’s livestock husbandry and production practices;
- Measure the value of household’s livestock, which are an important economic asset;
- Measure the cash and in-kind income from livestock, and hence the contribution of livestock to household’s livelihoods.

TABLE 1. CONTENT OF THE LIVESTOCK QUESTIONNAIRES FOR AGRICULTURAL/HOUSEHOLD SURVEYS

Livestock domain	Sections	Remarks
Livestock ownership	Number of animals Change in stock in past 12 months	Questions are asked for individual animals, often differentiated by age, gender and breeds (local/indigenous and improved/exotic), which helps to appreciate herd structure and inter-species composition.
Inputs and husbandry practices	Breeding Feeding Watering Animal health Housing	Questions are asked for major groups of animals (e.g. large ruminants, small ruminants, pigs, poultry birds, equines, other), as management practices usually do not differ between animals of the same species.
Monetary and non-monetary outputs	Meat production Egg production Milk production Animal power Dung	Questions are asked for major groups of animals, including both the monetary and non-monetary value of production.

Source: Pica-Ciamarra *et al.* (2013)⁵⁶

Three countries in sub-Saharan Africa have made use of these questionnaires in their multi-topic household surveys: Niger (Survey on Household Living Conditions and Agriculture 2011); Tanzania (National Panel Survey 2011/12); and Uganda (National Panel Survey 2011/12). Some results for Niger and Tanzania are presented below as an example of the type of information generated by these surveys.

“Statistical surveys with more and better coverage of the livestock sector drive investment.”

TABLE 2. NIGER AND TANZANIA: EXAMPLES OF HOUSEHOLD LEVEL LIVESTOCK STATISTICS

Niger	Tanzania
About 75 percent of rural households keep livestock, with an average herd of 2.7 Tropical Livestock Units.	About 60 percent of rural households keep some animals, with an average of 2.7 Tropical Livestock Units.
Although cattle constitute over 50 percent of the livestock population in the country, the representative household keeps mainly sheep and goats.	The richest 20 percent of livestock owners own approximately 81 percent of all non-commercially-owned animals.
Female-headed households tend to keep more small animals than do male-headed households.	About 65 percent of male-headed households keep some animals, vis-à-vis 51 percent of female-headed households.
About 25 of livestock-keeping households regularly vaccinate their animals.	Less than 30 percent of family-owned livestock is vaccinated.
About 20 percent of all livestock-keeping households hire labor.	About 4 percent of all livestock-keeping households hire labor.
Pasture, fodder and crop residues represent about 90 percent of large ruminants' feed.	20 percent of livestock-keeping households purchase feed for their animals.
Less than 16 percent of households keep improved or exotic breeds of animals.	25 percent of livestock-keeping households use animal dung as fertilizer.
Livestock-keeping households derive about 22 percent of their income from livestock.	Livestock-keeping households derive about 21 percent of their income from livestock.

Source: Bocoum *et al.* 2013⁵⁹ and Covarrubias *et al.*

INFORMATION GAPS: BUSINESS-ORIENTED LIVESTOCK KEEPERS

Designing and implementing policies and investments assisting business-oriented livestock keepers to increase the productivity and value at sale of their animals should be based on detailed information of their production and marketing practices: how many animals are kept in these systems, of what species and breeds; what are the prevailing breeding and feeding practices; what are the preferred market outlets, etc. As outlined above, these variables are difficult to isolate in many statistical systems. However, the larger problem is that the business-oriented livestock keepers are not readily identifiable, as in the best case they represent only about one-fifth of all livestock keepers. In addition, there is considerable heterogeneity within them due to sector (e.g. dairy vs broiler production), specialization (mixed system vs livestock specialization) and

stage of development (established, approaching retirement or newly invested). Identification and characterization of business-oriented livestock producers then seems largely impossible, based on currently available data.

Niger is a case in point, being a country in which livestock is widely held by rural households. The 2011 Survey on Household Living Conditions and Agriculture includes a sample of 2,430 rural households, out of which about 1,900 keep some animals. Among the livestock keepers in the sample, only 125 are not poor and derive more than 25 percent of their income from livestock. Among the latter, only 27 keep three or more cattle, which, as a sample, is insufficient to appreciate the characteristics of these types of market-oriented cattle keepers and the constraints which prevent them from increasing productivity and accessing/utilizing the milk or beef market²¹. Survey data from other sample countries, in which animals are less commonly held, are also insufficient to characterize business-oriented livestock keepers. For example, in Malawi and Nigeria only 38 and 4 households in the sample belong to the richest 20 percent and keep ten or more chicken or five or more sheep/goats, respectively^{18, 20}.

Table 3 presents data on herd size and composition for one randomly-selected business-oriented livestock keeper for each of the sample countries which, by definition, derives at least 25 percent of income from selling livestock products and live animals in the market. The data lack statistical power because, as said above, the samples are too small to generate statistics for business-oriented livestock keepers that have some significance.

“Current data doesn’t allow a characterization of business-oriented livestock producers.”

TABLE 3. INCOME FROM LIVESTOCK AND HERD SIZE/COMPOSITION FOR BUSINESS-ORIENTED RURAL LIVESTOCK-KEEPING HOUSEHOLDS

	Income from livestock (% of tot. income)	HERD COMPOSITION (no. of animals)			
		Cattle	Sheep/goats	Poultry	Pigs
Ghana	34.5	0	5	8	0
Madagascar	47.3	13	0	9	0
Malawi	44.1	0	0	104	2
Niger	71.7	2	15	40	0
Nigeria	42.5	0	6	25	0
Tanzania	40.6	0	2	18	0
Uganda	26.7	12	14	17	0

Source: Calculated from National Multi-topic Household Survey data¹⁷⁻²³

“Separate surveys are needed to understanding the incentives that drive business-oriented livestock keepers.”

Despite the lack of representativeness, Table 3 reveals that **households with incentives to increase livestock production and productivity can keep about a dozen cattle**, which is more than double the average cattle keeper’s number (see Figure 15); **about 15 sheep/goats**, which is three times the herd size of the typical small ruminant keeper’s (Figure 15); **and 20 or more chicken**, which again is a flock that is at a minimum twice the size of the average poultry-keeping household’s (Figure 15). By construction, livestock contribute at least to 25 percent of their income, but this contribution is shown to be as high as 70 percent in one case.



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Governments need to invest resources to better characterize market-oriented livestock keepers.

This requires undertaking specialized livestock surveys explicitly targeting selected households, which involves the appropriate sampling strategy. The information generated would be helpful in appreciating the characteristics of business-oriented livestock keepers and in formulating policies and investments aimed at enhancing the productivity of their animals. It can also drive investments aimed at assisting livelihood-oriented livestock keepers to make the transition to establishing successful livestock farms.

INFORMATION GAPS BEYOND THE FARM-GATE

Regardless of the targeting of national statistical surveys, these do not provide information on the root causes of production and productivity constraints, and are additionally insufficient to understand the reasons for limited access to input and output markets. Hence, they are not immediately useful in identifying investment priorities. For example, data that show that animal diseases and access to feed are major constraints to productivity don’t inform decision makers on how the prevalence of selected animal diseases can be reduced or how the use of supplemental feed can be promoted. Data on trading patterns based on questions such as “to whom did you mainly sell your milk in the last six months?” don’t provide major information to decision makers on how to facilitate output market access.

Governments should adopt supply chain approaches to appreciate productivity and market access constraints, focusing not only on farmers — as is often the case — **but also on other actors along the supply chains**, such as drug and feed producers and distributors, and traders, processors and retailers. Information about these actors, their success in livestock operations, and their practices and preferences, would allow governments to design policies and investments that facilitate them developing business models that are inclusive of both livelihood-oriented and business-oriented livestock keepers; the former as buyers of inputs and services and the latter as both buyers of inputs/services and suppliers of livestock products.

Finally, data on employment in livestock production and trade would also be of significant value to policy makers, as full-time jobs represent a major way out of poverty for the disadvantaged, i.e. all things being equal, labor-intensive livestock production systems should be given priority¹³⁻¹⁶. The literature, with few exceptions⁶⁰⁻⁶², provides little information about employment creation by the various models of livestock production and marketing. **Investments are needed to quantify the employment opportunities that can be generated along different livestock value chains, including on-farm, off-farm and non-farm jobs.**

CONCLUSIONS

A look at consumption and production of the livestock products in Africa leads to two major findings. First, **the growing market for animal-source foods represents a major opportunity for livestock keepers**. This is the case as a large share of consumers with limited income will continue to prefer the purchase of relatively low-processed low-valued livestock products in the coming years. Second, **only a small share of livestock keepers are business-oriented and have incentives to expand their production and tap into the growing market for livestock products**. The remainder, or **the majority of households, are livelihood-oriented livestock keepers, who can derive less significant benefits from regularly selling meat and milk to the market** even when productivity-enhancing technologies are readily available.

Investments aimed at enhancing the contribution of livestock should be differentiated depending on whether they target livelihood-oriented livestock keepers or business-oriented livestock keepers. Information on each type of livestock keeper, however, is currently insufficient to design effective investments in the sector.

To fill the information gaps for livelihood-oriented livestock keepers, expanding the livestock content of multi-topic household surveys is deemed sufficient to collect the information necessary to quantify the contribution of livestock to their livelihoods, and hence the investments these households have to make,

“In light of growing demand for livestock products in Africa, fostering business-oriented livestock keepers is critical for the development of the sector.”

and their willingness to make those investments. This is a key data entry point necessary to design policies and investments that help livelihood-oriented livestock keepers derive maximum benefits from their animals.

As to business-oriented livestock keepers, the statistical system is unable to generate information on them, as they are a difficult-to-identify small group. Livestock surveys explicitly targeting business-oriented livestock keepers are therefore recommended, with a focus on their production practices. The information generated could help in not only enhancing the productivity of their animals, but also in driving investments aimed at assisting livelihood-oriented livestock keepers in strengthening their operations and even moving toward business orientation.

Information should be also collected by targeting actors along the value chains — such as feed and drug suppliers, traders and retailers. These sell inputs and services to and purchase products from livestock keepers. Information on them would allow governments to design policies and investments assisting these actors in developing business models that are inclusive of livestock keepers — both as buyers and suppliers of goods and services — and would facilitate investments that can generate employment opportunities along the value chains.

Governments, regional institutions and the international community should jointly collaborate to collect and systemize critical livestock information to refine the proposed livestock for livelihoods and livestock for business development agenda. To this end, this paper has not only identified new groupings of livestock producers (livelihood- and business-oriented) but also categories of livestock value chain actors (retailers, traders and service providers) and livestock product descriptions (by cut and quality) that can be employed in designing livestock data systems.

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Evidence-based policies and investments based on the proposed livestock for livelihoods/ livestock for business development paradigm are anticipated to promote the advancement of a sector which holds much potential for pro-poor development and economic growth, and one which can play a critical role in responding to projected increases in food demand in Africa.

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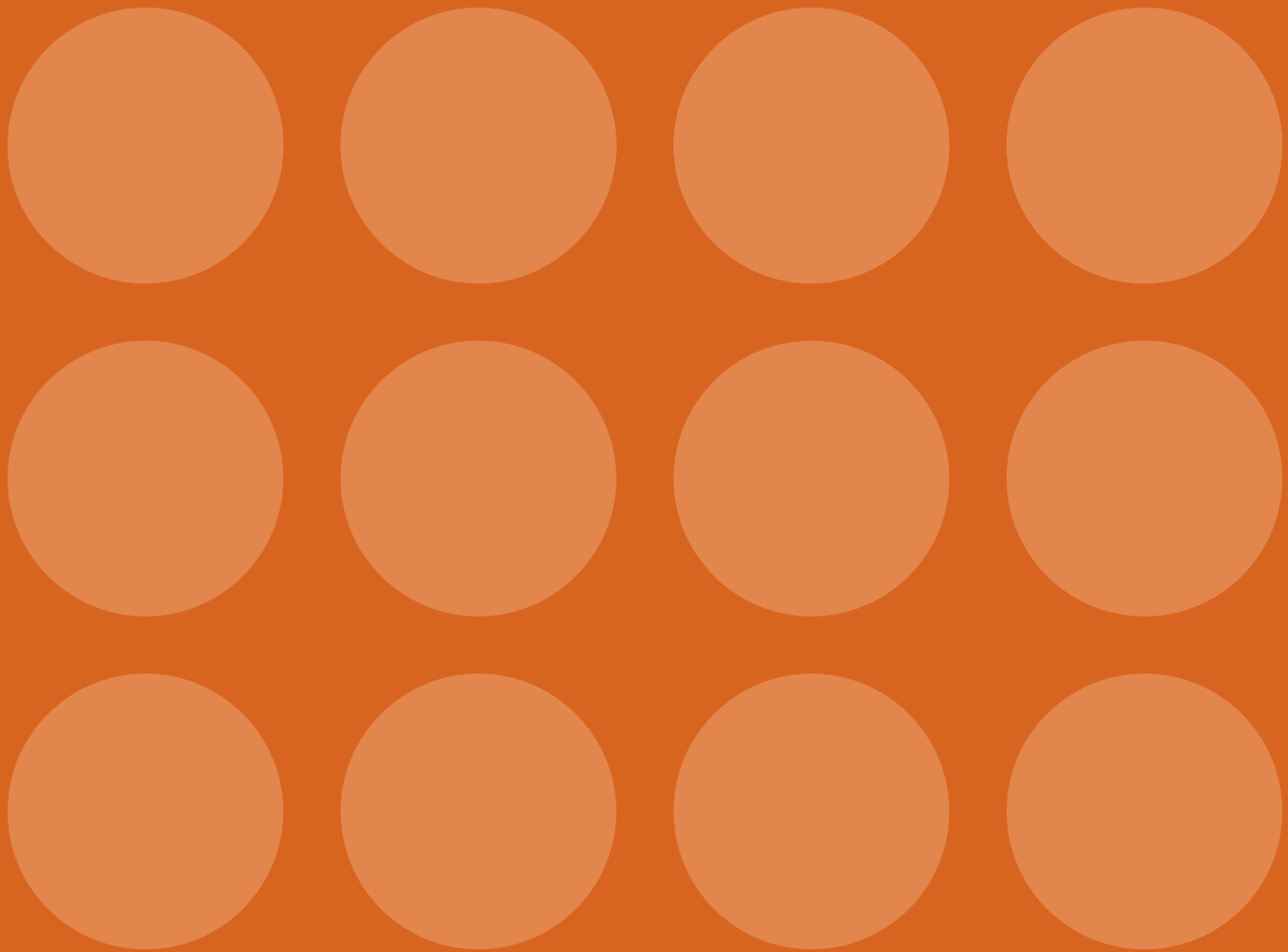
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